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Post-mining land uses

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Transformations in Mining Economies

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PROJECT PARTNERS

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Executive Summary

This Final Report presents the outcomes of work undertaken on behalf of CRC TiME into post-mining land uses in Australia and elsewhere. It provides insights developed from the review of academic work and other publications on the re-use of mines and is the second and final output from this project. It also presents eleven case studies of mines that have closed and been re-purposed or in the process of being repurposed, as well as a discussion of the challenges of acknowledging Aboriginal interests in this process. The overarching goal of this research was to answer the broader question of how best to advance the re-use of mines in order to achieve positive economic, social and environmental outcomes. It recognises that the repurposing of mines creates distinctive opportunities and risks for mining communities and their broader regions, and that there is value in seeking to find new, and productive futures for these places. The research focused on the following seven questions:

- What can we learn from national and international experience with respect to the re-purposing of mines?
- What are the adverse impacts of current closure planning processes?
- What are the optimal conditions for the re-purposing of sites with respect to location, mine type, engagement with the community and broader regional planning processes?
- How can the re-purposing of mine sites better incorporate long-term community priorities?
- Is repurposing best enacted immediately post mine closure, or is it better placed – and more likely to come to fruition – after a significant period has elapsed?
- What do we understand as current thinking or best practice in this field? and,
- What can we learn from case studies drawn from across Australia?

The review found that:

- Globally there are a significant number of instances where mines have been repurposed across a range of industries, including:
    - Active tourism, including mine sites as places for physical activity and adventure tourism;
    - Recreation uses and hotel accommodation;
    - Office accommodation;
    - The processing of waste and other materials in bio-reactors;
    - Science precincts;
    - Energy generation; and,
    - Environmental assets, including wetlands.
- While there is considerable case study literature on the re-use of mine sites, to date, the issue has not been considered in a systematic fashion. Those resources that are available, including The International Council of Mining and Metals' *Good Practice Guide* (ICMM 2019), provide valuable advice but it may be difficult to translate these insights into specific action for some mines;
- For Australia, our current, piecemeal approach to the re-purposing of mines results in lost economic opportunities, and potentially profound impacts within individual regions;

- The available evidence suggests that each example of mine repurposing has been dealt with as a unique, 'one off' project, with consequent significant implementation costs;
    - The case studies highlighted both the opportunities and challenges of mine re-purposing, and while there are very positive examples of successful re-use, other case studies demonstrate the various risks associated with that process;
    - A number of the case studies demonstrated the challenges arising from government regulatory arrangements;
    - The in-depth analysis highlighted the diverse sources of leadership – public sector, private sector, community – for successful repurposing; and,
    - The examples considered in this report conformed with broad patterns evident globally, including the focus on ecological/environmental uses; tourism as a post-mining land use; the importance of the mine infrastructure for allowing new forms of economic activity; and, the need to develop sustainable business models.
- In many instances the re-use of mine sites is made more difficult by regulatory frameworks that focus solely on harm minimisation and the rehabilitation of mine sites. There is often limited scope for consideration of alternative uses for these sites;
- Some features of contemporary mining practice, including the periodic shut-down and re-opening of mines as resource prices vary, make it more difficult to plan for repurposing as the end of mine life is difficult to determine. Staff turnover on mines placed on 'care and maintenance' may result in the loss of corporate knowledge, and the associated failure to implement previously identified plans;
- Drawing on broader research on change in regional economies we find there are three key questions that need to be considered systematically in order to better inform, and empower, mine repurposing in Australia and elsewhere:
    - What are the opportunities available at each mine site for redevelopment and the creation of new opportunities?
    - Who has the capacity to bring about change?
    - How is the process of change discussed publicly and in forums of influence?

Early insights into how to find solutions to these questions will be provided as part of this Final Report, and it is anticipated further investigations will be needed in order to provide industry with the tools they need to more systematically implement the successful repurposing of mines.

1 Introduction

This Final Report is the second of two industry-facing publications regarding post-mining land uses, produced as part of a project funded by CRC TiME. This report focuses on documenting both what is already known about this topic and on establishing the experience of a number of mine sites in Australia that have experienced either mine repurposing or are in the process of pursuing this goal. The Preliminary Report from this project focused exclusively on outlining the key lessons from the international literature, and this publication seeks to extend that work by combining that analysis with the investigation of specific incidences of mine repurposing.

As recent research has noted, abandoned or former mine sites are a common feature around the world, with Gutierrez (2020) estimating there to be approximately 500,000 such sites in the USA, 50,000 in Australia and 10,000 in Canada. Werner et al (2020) identified 95,320 mine sites in Australia, of which some 89 per cent were inactive. Mines and their potential for re-use are an important issue economically, socially and environmentally.

Over recent decades a number of reviews have been written on post-mining land uses, including detailed analysis of the characteristics of individual projects and their location (Holcombe and Keenan 2020; Mborah et al 2016; Limpitlaw et al 2014; and, Soltanmohammadi et al 2009). There has been a focus on some specific characteristics of individual mines such as the type of mining, the mineral resource, the remoteness of the mine location, and the impact of government regulation on the re-use of these sites. Other research has focused on issues of community consultation, the interests of Indigenous landowners and the potential to make use of new technologies to find innovative solutions to the future of these sites once mining has come to an end. This Report, however, takes a different perspective: it considers the nature of mining activity and its organisation as an industry – including government oversight – and considers how these shape the repurposing of mines. The report also looks at mines as important regional assets – drivers of economic growth, sources of employment and opportunity, and major infrastructure hubs – and what we can learn from recent research on how regions change to better understand mine site repurposing.

As we learn more, and develop better insights into, mine repurposing we are empowered to achieve outcomes that work for the benefit of all.

2 Context

2.1 Our goals and objectives

We know that across Australia and globally, former mines have been converted into a range of other uses, including their use for power generation, science laboratories (Productivity Commission 2017), adventure tourism and diverse other uses, but we lack a systematic evidence base on how these successes have been achieved and what hurdles have needed to be overcome in order to bring their potential for re-use to realisation. There is also a pressing need for better insights into how change has been achieved. This is, of course, a very broad question as it touches upon issues of governance, risk management, the impacts of incumbency with respect to mine operations and ownership and broader attitudinal factors, including expectations. It is important to acknowledge also that the repurposing of mine sites is affected by larger-scale economic opportunities and disruptions, as well as the appetite within the community, governments and businesses for risk. Who carries which type of risk – reputational, environmental, financial etc – can be an important consideration in the repurposing of mines.

This research has been undertaken as part of the program of work focused on questions of regional development and regional impacts within CRC TiME. The research seeks to provide answers to specific questions around the re-use of mine sites, and the opportunities for repurposing, now and into the future. The research asks seven key questions:

- What can we learn from national and international experience with respect to the re-purposing of mines?
- What are the adverse impacts of current closure planning processes which often set out what is to happen once a mining closes, without detailed analysis of all potential options?
- What are the optimal conditions for the re-purposing of sites with respect to location, mine type, engagement with the community and broader regional planning processes?
- How can the re-purposing of mine sites better incorporate long-term community priorities?
- Is repurposing best enacted immediately post mine closure, or is it better placed – and more likely to come to fruition – after a significant period has elapsed?
- What do we understand as current thinking or best practice in this field? and,
- What can we learn from case studies drawn from across Australia?

This Final Report provides insights into these questions and offers recommendations on how best to reposition the re-purposing of mines in order to achieve significant benefits for the economy and society at large.

2.2 Understanding mine sites as a regional economic asset

There is now a large and emerging literature focused on the repurposing of mine sites around the world that either specifically concentrates on that topic or includes a discussion of the issue as part of a broader understanding of the end-of-life for mines (see, for example, Young et al 2021). Internationally and nationally, there is no shortage of examples of mine sites that have been repurposed in many, very different, ways (Table 1) with former mines used to host tourism activities such as zip lines and bike trails, while also serving as sites for the recycling of materials, part of pumped hydroelectricity schemes and industrial parks. Germany's Lausatian Lakeland witnessed the transformation of an entire landscape affected by the impact of strip mining for brown coal developed into a tourism attraction. In the United States former mines have

been used to provide government offices, serve as a data storage hub and the site of a mushroom farm. Critically, the re-purposing of mines has received comparatively little attention in the academic literature relative to other mining-related issues, and the topic would appear to have limited prominence within the mining industry also. There is, however, clear evidence of a growing engagement nationally and internationally with this important topic.

2.3 Mining as a distinctive economic activity

Mining is an industry with distinctive characteristics. Mining in Australia and in many other parts of the world is an industry of national and international significance, with the minerals and other resources produced from mining a key input into global production networks (Coe & Yeung 2015). Mining, however, is differentiated from many other industries in that activity is concentrated in a specific site or sites, for a limited period that is usually known prior to commencement. In some instances, mining has persisted for generations and has supported townships and communities for an extended period, but in other cases the life of a mine may be less than two decades. As the ICMM (2019) acknowledged, mining is a temporary land use but its impact on the local environment and economy may remain evident long after the site has closed. Importantly, each mine is distinct: its location is unique, as are its configuration, resource base, potential environmental impacts, rehabilitation options and prospects for re-use. Mining, therefore, has much in common with the construction of infrastructure and other project-based economic activities, rather than industries with the capacity to continue over longer periods. As a project-based economic activity, post-mining land uses tend to be bespoke – tailored to the individual circumstances and opportunities evident at each site. Unlike in manufacturing, professional services or some types of construction, there is no system-wide response available for the re-use of mine sites that is able to be applied at scale with uniformly positive outcomes. Each repurposed mine site must be considered individually, with solutions shaped to those conditions. For this reason, much of the literature on post-mining land use appears as a collection of case studies (Decipher 2020; Murphy 2018; Verweijen & Dunlap 2021), with each setting out a response to a particular set of opportunities and challenges, but not necessarily building upon the commonalities that could be found with more detailed analysis.

Before moving on to examine some of the other distinctive elements of mining, it is important to acknowledge that the question of mine life is made more complex by fluctuations in the pricing of minerals and very often international market and political conditions. Mines may be viable when their minerals are at a favourable point in the price cycle, but uneconomic when prices fall below the cost of production. Mines may be placed on 'care and maintenance' until prices return to a higher level and extraction becomes profitable again. Mines may even be reopened even after repurposing, if this is still feasible. This practice introduces considerable ambiguity into the end of life for a functioning mine, especially as shifting prices, new markets, and further investment by the mining company may result in the expansion of the mine and an extension of its life.

Mine location is a second distinctive feature of the industry, especially in Australia. Unlike many other industries where there are advantages in being close to population centres (Beer & Clower 2019), some mines are in remote places while others are relatively close to large towns or cities. In large measure this variability reflects the location of the existing resources being extracted but, in some instances, it is a product of the incompatibility of industrial-scale mining in proximity to major urban centres. One consequence is that the infrastructure – power and water supply, roads, railways, airstrips and townships – created to support mining activities commonly represent a significant percentage of the infrastructure in undeveloped regions. These investments therefore represent important regional assets, potentially critical in the future development of that locality and its broader environment. In some instances it may be necessary to invest in new, complementary, infrastructure in order to make possible new industries and associated investment (AgroSense 2020). Who pays for this new infrastructure may be disputed, with the former owners of the mine, the community, governments and the new enterprise all interested stakeholders.

McCullough et al (2020) observed that pit lakes associated with abandoned open cut mines are potentially valuable to many regional communities but this opportunity may not be realised because of issues including water quality, slope stability and safety.

Third, mining is both a mature and a heavily regulated industry, where considerable attention has been paid to the consequences of mining activity and the desire to restore the land once mining has ended (Young et al 2021). In many instances, the restoration of the mine site is the only possible outcome: one mandated by mine licence conditions under state or other legislation (see Weller et al 2020; Hall 2020). These outcomes have been imposed because of a history of former mines remaining un-restored, with significant negative environmental impacts (Roche & Judd 2016). Some have argued this remains a risk across Australia and elsewhere (Walters 2016). In other instances, companies are encouraged to consider alternative uses for mines, but 'regulatory inertia and mining company aversion to risk inevitably results in closure criteria focused on environmental protection, with post closure land use defaulting to the pre-mining land use' (Jacobs 2018 p i). In many instances, rehabilitation is essential as there are significant issues of contamination or danger on-site; the Rum Jungle mine in the Northern Territory is a case in point. Rehabilitation, however, is expensive and in a number of instances mines are not closed formally but are instead 'mothballed', placed in 'care and maintenance' indefinitely, until eventual abandonment. Legislative requirements focused on mine rehabilitation may make it difficult to repurpose a mine, and this may represent the loss of a significant economic opportunity for the local community.

Fourth, mining and the re-purposing of mines is an issue that brings forward many stakeholders with often differing perspectives and agendas. Mining companies, government agencies, the local community, industry, unions and environmental groups may all have distinct agendas. Critically, while mining companies can benefit from the re-purposing of mines through reduced rehabilitation costs and reputational benefits, some stakeholders may be strongly interested in the re-use of a mine but have little power with which to shape outcomes. This would include First Nations peoples, other local communities, economic development agencies and companies seeking to make use of the mine's land and/or infrastructure potential (Kirton & Anthonisz 2020; AgGrow nd).

The closure of any mine brings to an end one form of economic activity on that site, which may mean mining ceases in the region entirely. Mine closure commonly results in the loss of employment for many workers, although staff may be redeployed by large companies to other sites (Weller et al 2020; Kalogiannidis 2020; O'Connell & Arnau 2020). Mine closures may also result in reduced economic activity in a region, which in turn contributes to reduced turnover and employment in supporting firms and local townships. Put simply, mine closure may be a significant shock to the regional economy, and there may be a social and economic imperative to reuse mine sites to help sustain the local economy and make full use of the infrastructure in place.

Importantly, in many developed economies the pathway to mine reuse is both time consuming and potentially influenced by a substantial number of hurdles. Essentially for a mine to be repurposed, the site needs to pass through a number of gateways (Figure 1) all of which may undermine the viability of the proposed re-use. These barriers include regulations that may mandate particular outcomes – such as the rehabilitation rather than the re-use of sites; what is technologically feasible at this point in time; the economics of repurposing, including the possibility of needing to undertake significant remediation or reconfiguration of the site prior to re-use; and community attitudes and sentiments.

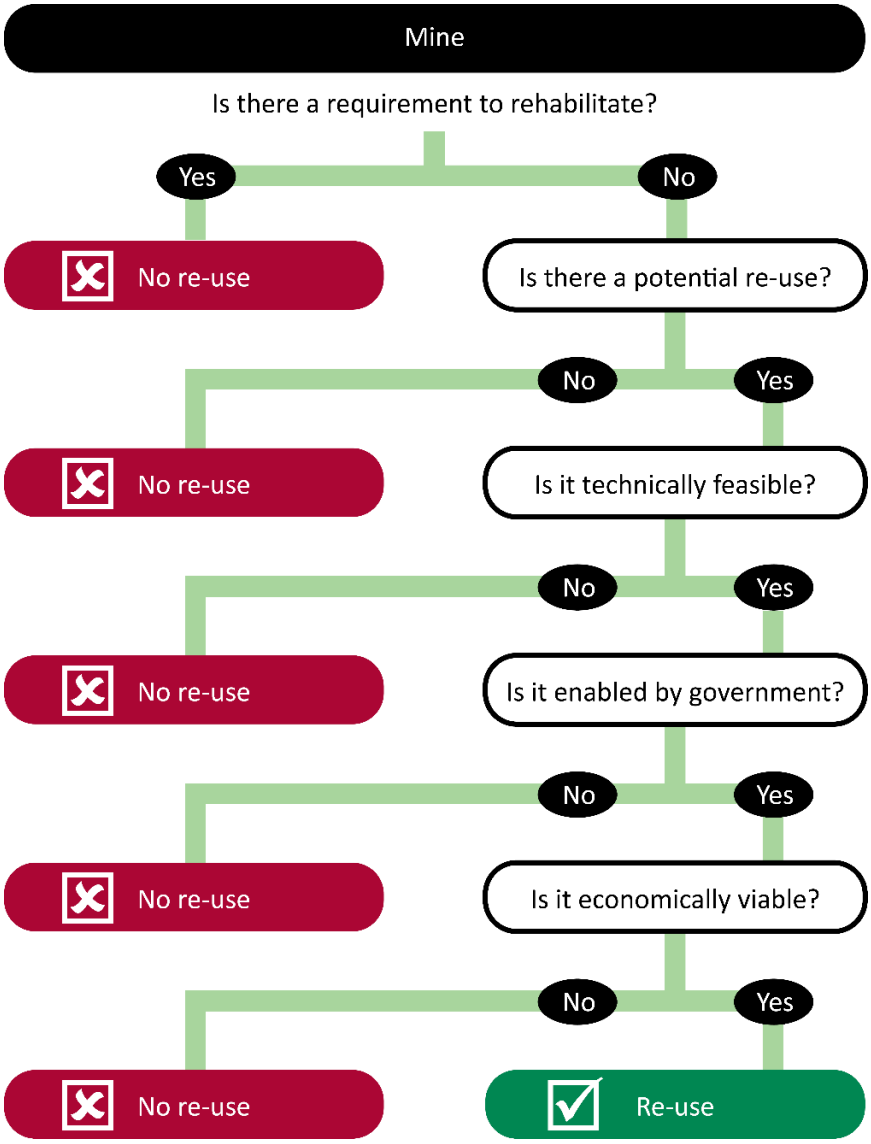


Figure 1: A stylised set of gateways for mine site repurposing[1]

Recent research into how regional economies change provides a valuable perspective on how to think about, and plan for, mine closures. Beginning with Grillitsch and Sotarauta (2020) researchers have acknowledged there are three over-arching questions and nine supporting questions that must be addressed in seeking to understand how change takes place (Beer, Barnes & Horne 2021). Translated to fit the goal of better understanding mine re-purposing, these nine questions are:

- What are the opportunities available at each mine site for redevelopment and the creation of new enterprises?
    - Do these opportunities emerge from, or are dependent on, new technologies?
    - Are these opportunities a product of conditions unique to, or a product of, that location? Do the enablers of transition include land capability/capacity, infrastructure assets, water availability and other features associated with the mine?

[1] Figure 1 does not imply that re-use and rehabilitation/remediation are incompatible. Indeed, as demonstrated in the case studies, some forms of re-use are only possible after extensive remediation.

  - To what degree do these opportunities reflect the resource endowments of that site and its region?

- Who has the capacity to bring about change?
  - Does the leadership of change sit with the private sector?
  - What is the role of the public sector – in all its dimensions – in leading and enabling the transition of former mines to new forms of economic activity?
  - What is the potential role of the local community, First Nations people and those who speak on behalf of the community?
- How is the process of change discussed publicly and in forums of influence?
  - Is there a narrative of change that focuses on the regulation of the mine and the minimum thresholds it must achieve post closure?
  - Is there a discussion of how to bring about positive change, enabling the capture and realisation of the potential re-use of the site? And,
  - Can a partnership between private sector and government stakeholders better explore the full range of possible outcomes for mine sites, including re-use?

Providing answers to these questions represents a first step towards a more systematic and evidence-based approach to the repurposing of mines and the full development of the opportunities they represent. For Australia, our current, piecemeal approach to the re-purposing of mines results in lost economic opportunities, and potentially profound impacts within individual regions.

Table 1: Examples of some re-purposed mines

Site	Location	New Purpose
Selby Coalfield	North Yorkshire, UK	Industrial park, business park, waste processing, storage
The Eden Project	Cornwall, UK	Botanical garden/concert venue
Zip World	Wales	Adventure tourism
Louisville Mega Cavern	Kentucky, USA	Mega underground bike park
Green Forests Work (non-profit)	Virginia, USA	Daniel Boone National Forest (restored forest)
White Pine Mine	Michigan, USA	Plant nursery for a biomedical company
Former gold mine at Lead	South Dakota, USA	Physics lab
Former mine in upstate NY	New York, USA	Data storage
Former limestone mine at Boyers	Pennsylvania, USA	Room 48, data storage
Former mine at Boyers	Pennsylvania, USA	Government office
Creekside Mushrooms Ltd	Pennsylvania, USA	Mushroom farm
NRG Dewey Prairie Garden	Jewett, Texas, USA	Farm
Lake Ore-Be-Gone	Minnesota, USA	Artificial lake
Butchart Gardens	Vancouver Island, Canada	Sunken garden
Springhill Mine	Nova Scotia, Canada	Flooded sub-surface coal mine with geothermal energy providing heating to several commercial buildings
White Mountain Publications	Ontario, Canada	Independent bookstore

Former limestone quarry	Dalarna, Sweden	Dalhalla concert venue
Gotland Ring	Gotland, Sweden	Subterranean racetrack
Lefdal Mine	Norway	Data Centre
Zollverein Coal Mine	Germany	Entertainment hub
Salina Turda	Transylvania, Romania	Amusement park
Wieliczka Salt Mine	Poland	Underground spa, museum
Roman Catholic Church	Zipaquirá, Colombia	Salt cathedral
Clube de Braga	Portugal	Soccer stadium
Tianma Pit	Shanghai, China	Shimao Wonderland InterContinental Hotel
Former iron-ore mine	Yanahara, Japan	Hypoxic running track
Kebun Raya Megawati Soekarnoputri	Indonesia	Botanical garden
Fassifern Coal Mine	Fassifern, near Newcastle, New South Wales	Pumped hydro energy storage facility [planned]
Schwenkes Dam	Greenbushes, Western Australia	Wetland habitat
Lake Kepwari	Collie, Western Australia	Recreational facility
Peak Hill Open Gold Mine	Peak Hill, New South Wales	Tourist attraction
Laverton	Western Australia	cARpeT: Reclaiming the Void art project
Hannan's North Tourist Mine	Mullingar, Kalgoorlie, Western Australia	Tourist attraction
Gove	The Gove Peninsula, East Arnhem Land, Northern Territory	Industrial and recreational areas

2.4 Approaches to end of mine life and mine site reuse

Recently Weller et al (2020) examined the International Council of Mining and Metals' Integrated Mine Closure Good Practice Guide (ICMM 2019), as an influential document within the mining sector globally and as a source of insight into the perspective of mining enterprises. That Good Practice Guide emphasised stakeholder involvement in the processes surrounding mine closures and emphasised the degree to which mining firms should be held responsible for longer-term economic development outcomes. As a key industry resource it provided guidance on how to repurpose mine sites as part of its examination of land use after closure, but concluded that:

> *Not all closed sites will be amenable to repurposing. In some instances, only certain domains may be available for repurposing. If the screening identifies an alternative land use and a positive business case can be developed, this approach may be incorporated into the mine closure plan. Prior to incorporation in the plan, the repurposing must be the subject of engagement with stakeholders to ensure the option aligns with what the community and government desires (2019 p 86).*

The International Council of Mining and Metals' Good Practice Guide (ICMM 2019) is an important resource for the repurposing of mines and it places an emphasis on stakeholder involvement in the closure process. The Guide's Tool 4: Screening Alternatives for Repurposing notes that 'there is a growing body of successful repurposing case histories …. with a productive repurposing of the land secured, repurposing facilitates the relinquishment of the former mine site (ICMM 2019 p 86). This Tool provides broad-scale guidance on how to repurpose mine sites, but it clearly cannot provide detailed advice on all possible sites and circumstances.

The ICMM (2019) Good Practice Guide is highly influential and often cited. Its key elements, outlined in Box A, concern engaging with stakeholders in what is essentially a firm-led process.

Box A: The ICMM Good Practice Guide

The guide begins from the position that mine closure processes form an "integral part of the mine operations' core business". It lists the key elements of mine closure planning and plan implementation, including the environmental, social and economic aspects of mine closure" (ICMM 2019 p 6).

The Guide stresses the involvement of the community and stakeholders throughout the closure planning process. It advocates learning from previous experiences.

The need for stakeholders to agree on success criteria is also crucial (p 37). This should include the identification of "leading indicators" to guide the monitoring closure activities and to ensure successful closure outcomes (ICMM 2019 p 38). Effective closure planning is characterised by:

- consistent and transparent engagement with stakeholders.
- community participation in planning and implementing actions that underpin successful closure.
- stakeholder support of closure decisions.
- better management of closure throughout the mining life cycle.
- more accurate closure cost estimates.
- early identification of risks and mitigation strategies.
- progressive reduction of liabilities.
- working towards an agreed-upon vision for the post-closure period.
- a better social transition for affected stakeholders as the mine moves from operations to closure.
- opportunities for lasting benefits being recognised and planned for adequately

In relation to transition, this publication views best-practice as restricted to managing the process, by "promot(ing), to the extent practical, a smooth transition from the socioeconomic conditions that existed during mining activities to the state that will be present after mining. Where practicable, the net socioeconomic impact on the affected region should be beneficial" (ICMM 2019 p 17). It also recognises mine closure can create opportunities to "encourage the development of sustainable post-closure

The ICMM Guide included a risk assessment flow chart to be used in identifying risks associated with closure and how to deal with them.

The ICMM guidelines are valuable, but they are limited by their universality in that they were developed regardless of the capacities of local institutions and regulatory frameworks. A more fine-tuned approach is needed across Australia, as each state and territory imposes their own regulatory frameworks and expectations.

Within Australia, the Commonwealth Government's Department of Foreign Affairs and Trade (DFAT) has developed a best practice guide that is more relevant to both Australian mines and Australian mining companies working internationally (Commonwealth of Australia 2016). The Government of Western Australia (2015) has also developed mine closure guidelines.

Both the DFAT and the Western Australian Government documents approach the issue of mine closure and mine repurposing from a regulatory perspective. This has resulted in a continued focus predominantly on the physical, site specific, environmental requirements for mine closure and site rehabilitation. Their overall

message on best practice is similar to the ICMM report, but with more emphasis on adopting 'leading' practices as a prerequisite to mining's 'social license to operate'.

Like the ICMM, the DFAT Guide stresses stakeholder engagement (but including regulators), agreement on a clear set of closure objectives, and a clear 'performance framework' able to facilitate a consistent approach and enable the success of the closure process to be measured. The DFAT guide is focused on legal compliance, recommending the needs of stakeholders and proponent criteria are a part of the initial mine approval process to ensure that companies relinquishing mine sites meet regulatory requirements and community objectives. It also recommends a Life of Mine (LoM) risk management approach to identify risks and develop controls to guide mine closure, rehabilitation and relinquishment. It recommends the AS/NZS ISO 31000:2009 Risk management— principles and guidelines (Standards Australia/ Standards New Zealand 2009) for that purpose. The Western Australian Guidelines provide detailed information on statutory requirements (Government of Western Australia 2015).

The DFAT Guide (Commonwealth of Australia 2016) directs more attention than the ICMM Guide to long-term outcomes. In its view, community capacity building and stakeholder/community engagement throughout the closure process is fundamental to providing "long-term positive outcomes" within affected communities (Commonwealth of Australia 2016 p 28). The DFAT guide's international case studies provide examples where mining companies have remained invested in the community through establishing education and training centres and assisting the expansion of other industries within affected regions.

A third perspective on mine closure and re-use was presented by Bainton and Holcombe (2018), who viewed mine closure from a community and environmental perspective. Although developed out of analysis undertaken in a developing economy (Ok Tedi in PNG), this research made observations and recommendations of considerable value.

For Bainton and Holcombe (2018 p 472) best practice in planning for mine closure and re-use called for a focus on both integration and sustainability. As well as the issues canvassed in the other guides – considering mine closure prior to the start of mine operation, stakeholder engagement, formal planning, goal setting and measurement of outcomes – they put much more emphasis on active community engagement. This, they argued, entails involving local communities in the design for mine closure process and in the setting of goals, developing resources and local capabilities ('social capital') to better manage the closure, building genuine partnerships among stakeholders, and establishing multi-disciplinary teams (internal and external) to work on different aspects of the closure.

Bainton and Holcome (2018) also stressed the need for communication with the community in order to build social cohesion, share inter-generational perspectives on the mine's lifecycle, and acknowledge the past. It also provides an opportunity to drawing on exemplary closure processes from other places (see also Weller et al 2020).

Because mine closures are an integral aspect of mining enterprises, Bainton and Holcombe (2018) viewed closures as manageable through local level agreements with communities and affected landholders, and not as exceptional events requiring government intervention. The authors saw mine closure as presenting a positive opportunity for communities to build 'local capital' in its natural, produced, human, financial, social and cultural forms, as a way of forging "the foundations for a more sustainable post-mining future" (Bainton and Holcombe 2018 p 469).

To that end, Bainton and Holcombe (2018) argued that the collaborative mine closure process should be structured to involve activities such as:

- repurposing mining infrastructure and landscape;
- reskilling and redeploying labour;
- establishing alternative economic opportunities; and,

- strengthening local livelihoods.

Bainton and Holcombe (2018) extended the responsibilities of firms beyond the boundaries of the industry and government perspectives. However, the expectation of long-term commitments by firms was limited to mine closures in developing countries where governments do not have the financial or management capacity to intervene to ensure positive outcomes (see also Commonwealth of Australia 2016).

The Centre for Social Responsibility in Mining (CSRM) at the University of Queensland has produced an online resource on the social aspects of mine closure https://www.mineclosure.net/projects that provides a number of insights into various dimensions of the closure process. With a strong focus on professional development and international Indigenous exchange, the CSRM has examined a number of research questions including:

- Woodlawn mine site repurposing: success factors, enablers and challenges;
- Indigenous groups, land rehabilitation and mine closure: exploring the Australian terrain;
- Examining mine closure through the lens of industry social practitioners;
- Mining regions in transition – a global scan;
- Community participation in mine closure planning processes;
- Participatory processes, mine closure and social transitions;
- Mining as a temporary land use: industry-led transitions and repurposing;
- Integrated mine closure planning: a rapid scan of innovations in corporate practice;
- Government engagement: insights from three Australian states; and,
- Social aspects of mine closure: governance and regulation.

Of these projects the most relevant to this Final Report are the work on mining as a temporary land use (Holcombe & Keenan 2020), as well as the examination of the development of the Woodlawn mine into a bioreactor (Holcombe 2020) and the consideration of community consultation processes in planning for mine closure (Everingham et al 2020).

Holcombe and Keenan (2020) undertook a global review of re-purposed sites as part of their work on mining as a temporary land use. They found 313 sites around the globe and from their analysis they concluded that the most common category of repurposing was 'community and culture'. This category includes: cultural/historical precincts, reclamation art, museums or exhibitions of mining/industrial history, and community event spaces. This form of repurposing emerged 76 times in our sample…. However, this form of repurposing was not usually led by industry and tends to relate to abandoned mines and/or historical sites….The next most predominant repurposing practice we found was 'conservation and ecosystem services' at 63 occurrences. This category encompasses wildlife habitat, native woodlands, carbon offset and sequestration, and wetlands Non-intensive recreation is the third most predominant category of land use with 51 occurrences. This category encompasses park and open green space, public/botanical gardens, paths for walking, hiking, running, cycling and horse-riding and eco- tourism. Of note, is that the categories of 'conservation and eco-system services' and 'non-intensive recreation', together make-up more than one third of the total in terms of primary re-purposing categories. And, as repurposing activities, they are co-located at least 37 sites (Holcombe & Keenan 2020 p v).

Holcombe and Keenan (2020 p 6) also concluded that the following attributes appeared to influence the likelihood of mine reuse. With respect to mine location the critical factors were:

- Proximity to one or more urban settlements;
- The attachment local residents may feel towards a mine and its working history;

- Connection to infrastructure;
- The environmental status and potential of the mine; and,
- Land use zoning.

With respect to economic viability, Holcombe and Keenan (2020) concluded that the critical issues included:

- Local supply and demand for the goods or services to be produced at the repurposed mine;
- A coming together of inter-related projects that assist each other in achieving viability; and,
- The potential to diversify into alternative energy projects or real estate development.

The factors internal to the mining company found to be important included:

- Regional stakeholder engagement and the company's willingness to look beyond their immediate operations, as indicated by:
    - The level of community engagement and commitment to being inclusive;
    - The establishment of community trusts and similar legacy schemes;
    - Company policies and standards; and,
    - The length on the mine life. With long-life mines more likely to result in post-mining land uses, in part because of enduring attachment to the community. Small, locally based operations, such as quarries, were also more likely to invest in re-use of the site.

Overall, the work reviewed above provides considerable insight into both the principles that should inform the repurposing of mines, and the extent and reality of such efforts to date. Holcombe and Keenan's (2020) research is particularly relevant to this Final Report as it provides invaluable insights into some of the factors that appear to shape the likelihood of re-use. What is needed are processes and competencies to better identify and assess repurposing options, which then needs to be accompanied by collaboration with partners (the mining company, governments, communities and other industries) to realise these opportunities. The University of Queensland's Centre for Social Responsibility in Mining *Knowledge Hubs* https://smi.uq.edu.au/csrm-knowledgehub

Box B: Social aspects of mine closure
https://www.mineclosure.net/projects

- Woodlawn mine site repurposing: Success factors, enablers and challenges https://www.mineclosure.net/elibrary/woodlawn-mine-site-repurposing
- Indigenous groups, land rehabilitation and mine closure: exploring the Australian terrain (Phase 2) https://www.mineclosure.net/elibrary/indigenous-groups-land-rehabilitation-and-mine-closure- exploring-the-australian-terrain-phase-2
- Examining mine closure through the lens of industry social practitioners https://www.mineclosure.net/elibrary/innovations-from-practitioners-lessons-learned-from-specialist-and-site-based-practitioners
- Mining regions in transition - a global scan https://www.mineclosure.net/elibrary/mining-regions-in- transition-a-global-scan
- Community participation in mine closure planning processes https://www.mineclosure.net/elibrary/mine-closure-planning-and-community-participation-structures-and-mechanics
- Indigenous groups, land rehabilitation and mine closure: exploring the Australian terrain https://www.mineclosure.net/elibrary/indigenous-groups-land-rehabilitation-and-mine-closure-exploring-the-australian-terrain
- Participatory processes, mine closure and social transitions https://www.mineclosure.net/elibrary/participatory-processes-mine-closure-and-social-transitions
- Mining as a temporary land use: industry-led transitions and repurposing https://www.mineclosure.net/elibrary/mining-as-a-temporary-land-use-industry-led-transitions-and-repurposing
- Integrated mine closure planning: A rapid scan of innovations in corporate practice https://www.mineclosure.net/elibrary/integrated-mine-closure-planning-a-rapid-scan-of-innovations-in-corporate-practice
- Government engagement: insights from three Australian states https://www.mineclosure.net/elibrary/government-engagement-insights-from-three-australian-states

This Final Report has provided a succinct review of the literature on the repurposing of mine sites. It has shown that the re-use of mines is an important, but under-researched, topic that has not received a great deal of attention in the research, policy or industry literature. In consequence the repurposing of mines in Australia and elsewhere appears to be unsystematic, with solutions and processes tailored to the circumstances of each location and dealt with as an individual project, rather than an instance of a global, system-wide, trend. This in turn has resulted in relatively few sites being repurposed, with consequent costs with respect to undeveloped opportunities for industry participants, the local community and region, as well as broader national economies. However, around the globe there are innovative examples of the re-use of mines and these instances provide examples of how to find better solutions to the challenges of mine reuse.

This Final Report has drawn together some of the work that has attempted to provide a more comprehensive insight into mine closures and the reuse of those sites. It has examined the ICMM (2019) *Good Practice Guide*, the guide from the Australian Government (Commonwealth of Australia 2016) and

published work by Bainton and Holcombe (2018), as well as the Knowledge Hub produced by the Centre for Social Responsibility in Mining. Overall this body of work provides an important, and valuable, starting point for better understanding mine reuse, but more needs to be done in this important area of research and practice if Australia is to make better use of the opportunities embedded in mine sites.

To sum up, there is no single notion of best practice in mine closures. The mining industry and community perspectives operate from the assumption of limited government regulation of the process. The Australian Government's (Commonwealth of Australia 2016) guidelines promote the use of regulatory controls and extend the closing firm's responsibility beyond management of the immediate repercussions of closures. The ICMM and the Australian Government guidelines both conclude that the responsibility of firms does not continue indefinitely after closure, which implies setting an agreed time limit on the firm's responsibilities. This also implies that the benefits of mine ownership – which may include rights such as access to and use of water – are also time limited. The strength of this literature is its detailed knowledge of rehabilitation issues. However, as Table 1 has shown, there appears to be limited knowledge within the broader academic literature or mining community of success in re-purposing of mine sites despite highly impactful research including that undertaken by Holcombe and Keenan (2020).

The research is focused on seven key research questions and it is possible, through the work undertaken to inform this Final Report, to provide interim solutions to some, though not all of these issues.

RQ1: What can we learn from national and international experience with respect to the re-purposing of mines?

We can conclude that the repurposing in mines for economic, social and environmental benefit is more common than is acknowledged by the public, the mining industry or academic research. Around the world former mines are used for a wide diversity of purposes, and while not all mines, or all types of economic activity, are appropriate for re-use, there is considerable potential to add to community and regional wellbeing through such transformation.

Often mines represent both unique regional assets, and important concentrations of infrastructure that should be repurposed for the betterment of the host region.

RQ2: What are the adverse impacts of current closure planning processes which often set out what is to happen once a mining closes, without detailed analysis of all potential options?

Current planning processes in Australia bring with them a range of unintended outcomes. Where these are negative, much of this impact comes from a perspective that emphasises the desirability of rehabilitating sites while simultaneously paying little attention to the potential re-purposing of these places.

In many instances, there is little scope to consider alternative land uses and their economic, social, or environmental benefits.

RQ3: What are the optimal conditions for the re-purposing of sites with respect to location, mine type, engagement with the community and broader regional planning processes?

To date, it is not possible to shed substantial new insights into this Research Question, except that it would appear reasonable to conclude that many mine types, in many locations, have the potential for reuse. This translation from potential to reality is, however, dependent on regulatory requirements, the types of re-use

available within the characteristics of the site and the current technological envelope, the economic viability of re-use and community acceptance.

Importantly, it is clear from the work of Bainton and Holcombe (2018), the Government of Australia (2016) and Weller et al (2020) that early engagement with the community and regional planning processes is essential.

RQ4: How can the re-purposing of mine sites better incorporate long-term community priorities?

The review of the literature has highlighted the importance of early engagement with the community, or communities, affected as well as with government agencies and other decision makers.

RQ5: Is repurposing best enacted immediately post mine closure, or is it better placed – and more likely to come to fruition – after a significant period has elapsed?

It is clear from the evidence globally that some mines have been repurposed relatively soon after closure while others have been repurposed after a considerable period has elapsed. All things being equal, it would appear that in Australia a site is more likely to be repurposed successfully if planning for its re-use is well under way prior to closure and that change is implemented in a relatively speedy fashion. Timing is important for a number of reasons, of which the need to act before infrastructure is removed, or the site degraded, are prominent.

RQ6: What do we understand as current thinking or best practice in this field?

It is difficult to document best practice in mine repurposing as while the ICMM (2019) and Bainton and Holcombe (2019) have both provided important insights, there are few insights into the practices currently followed by mining companies currently. Industry informants suggest that many mine operators seek to repurpose mine sites and routinely consider the opportunities, but there has not been an audit of the uptake of this practice and the impediments firms experience to its realization. This finding highlights the importance of both the work being undertaken by CRC TiME broadly, and the specific activities of the Regional Development theme within the CRC.

RQ7: What can we learn from case studies drawn from across Australia?

Research Question will be answered by the next stage of this project when the outcomes of a number of case studies across Australia will be presented.

Finally, it is important to restate, that in the longer term we will need to develop a more comprehensive, systematic perspective on mine reuse that provides scope to take full advantage of the opportunities these sites present for their host communities and regions. We currently do not know the value of the opportunities that are being foregone because of the failure to consider mine site repurposing as a priority, but it is clear that it comes as a significant lost opportunity for Australia.

3 Overview of case studies

The following section presents eleven case studies of mine site repurposing in Australia. The research was undertaken in 2021 and the outcomes reported here reflect developments at that point in time. The following section also includes consideration of the prospects and processes for recognising Indigenous interests in post- mining land use, and this topic is included as it was recognised as an important question in the formative stages of the overarching project.

The case studies considered included:

- Post-mining land use options (PMLU) in Moranbah Region, Queensland;
- Kidston Clean Energy Hub, Queensland;
- Lake Kepwari: Collie coal mine, Western Australia;
- The FAWNA Inc. Wildlife Hospital and Kaatijnup Biodiversity Park, Capel, Western Australia;
- Hannan's North Tourist Mine, Kalgoorlie, Western Australia;
- Newmont Boddington Gold Mine, Western Australia;
- Hazelwood Lignite Mine, Latrobe Valley, Victoria;
- The Eden Eco-Tourism Redevelopment, Anglesea, Victoria;
- Stawell Underground Physics Laboratory (SUPL), Stawell, Victoria;
- Gove Bauxite Mine, Gove Peninsula, East Arnhem Land, Northern Territory; and,
- Indigenous Interests Directory Pilot.

In many respects, each of the case studies tells their own story. The individual circumstances, opportunities and drivers for a repurposed future vary, but at the same time it is possible to recognise some commonalities across the individual sites. Importantly, we can also identify many of the themes acknowledged globally: the way some industries seem to appear most commonly in discussions of post-mining futures; the importance of economic opportunities and business models in shaping a sustainable future for these sites and the communities they support, and the complex interaction with regulatory frameworks. The case studies highlighted both the opportunities and challenges of mine re-purposing, and while there are very positive examples of successful re- use, other case studies demonstrate the various risks associated with that process. A number of our case studies remain 'works in progress', with uncertain futures, shifting government priorities and a greater appreciation of the depth of the challenge as more becomes known as the plan to repurpose the site gathers momentum. Regulatory frameworks determine – to a very large degree – what is possible and who can take action to convert mines that have ended – or are about to end – their economic life into other uses.

The in-depth analysis has also highlighted the diverse sources of leadership – public sector, private sector, community – for successful repurposing. Across the case studies, key agents for change have included former mining workers able to mobilise community interest and exert political influence, current mining companies, state governments and businesses outside the mining sector looking to develop new opportunities.

We also see through the case studies a strong focus on the repurposing of sites for environmental benefits and/or tourism activities. In many respects these types of new land uses make limited demands on the former mining site. They also carry relatively few risks, as individuals are not exposed to many of the hazards found in mines – although the management of risk remains an ongoing concern. Finally, it is also important to acknowledge that there is a business dimension evident across the eleven case studies: some of our

illustrative examples have required ongoing subsidies from industry or government, while others sought to generate passive assets that support tourism or related activities, but require little ongoing investment. Clean energy uses represent one of the emerging opportunities for some mine sites, as there can be a clear pathway to a sustainable business model and the re-use of existing transport and power infrastructure will add to the attractiveness of the investment.

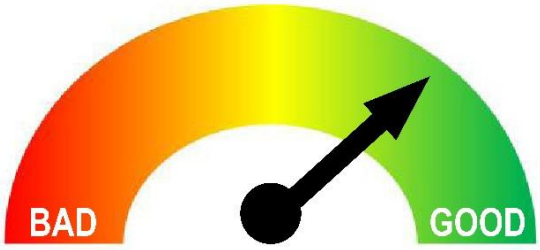
4 Case studies

4.1 Post-mining land use (PMLU) options in Moranbah Region, Queensland

Dashboard

Progress to date:

Prospects for success:



What is the vision?

In Queensland, the introduction of the Mineral and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act) has imposed a new life-of-mine planning instrument (Progressive Rehabilitation and Closure Plan or PRCP). This legislation has drawn significant attention to mine rehabilitation nationally, resulting in considerable interest for proactive initiatives on mine rehabilitation and closure matters. The reforms present an opportunity to review current rehabilitation practices and identify the potential for innovation in delivering post-mining outcomes, as the ones currently listed in the mines' permits have been imposed at commencement of the resource activities without detailed analysis of all potential options. There is potential to shift the perception of rehabilitated land as solely a liability, as it can lead to a range of beneficial uses.

Mines in Queensland will transition from the old to the new legislative framework over a 5-year period. There is potential to analyse options at regional scale, rather than for each individual mine, which may be more beneficial as it can lead to a regional vision that incorporates all economic, environment and social perspectives in defining a post-mining future.

Anglo American, BHP and Peabody identified an opportunity to undertake a pilot study to test a methodology on a small sample of mine sites that could later be applied to any mining region. The objectives of the pilot study were to establish an understanding of potential post-mining land use (PMLU) options for the Moranbah region, to identify long-term community priorities, planning constraints and opportunities, and to investigate collaborative opportunities for beneficial use of post-closure mine assets.

What has been achieved so far?

Post-mining land uses (PMLUs) were identified by reviewing the international and national context; identifying the technical advances in agriculture, horticulture, aquaculture, residue management, water treatment and water supply that could be incorporated to support or create a PMLU; and reviewing status and requirements of the renewable energy sector. The technical feasibility of each PMLU was assessed (where relevant) and an overview of the key requirements for the success of the PMLU provided.

The assessments included information on community preferences, development goals and priorities. These were summarised in terms of the Five Capitals framework (Economic, Social, Built, Human, Natural) and provided a description of valued regional assets, community development aspirations and perspectives on PMLU, company visions of PMLU, and regional and state development visions. The consolidated knowledge base was used to derive the Moranbah region's strengths, weaknesses, opportunities and threats (SWOT) for post-mining future. The SWOT provided a high-level picture of the most important factors that will impact on the post-mining future of the region.

Key actions were outlined to assist the Moranbah region transition to post-mining land use alternatives. The recommendations identified a number of technically feasible PMLUs that could present opportunities for collaboration. They included conservation; education, training and innovation centre; improving regional water security; and renewable energy. It was also noted that co-located initiatives would hold the most promise.

4.1.1 Background

Type of mine

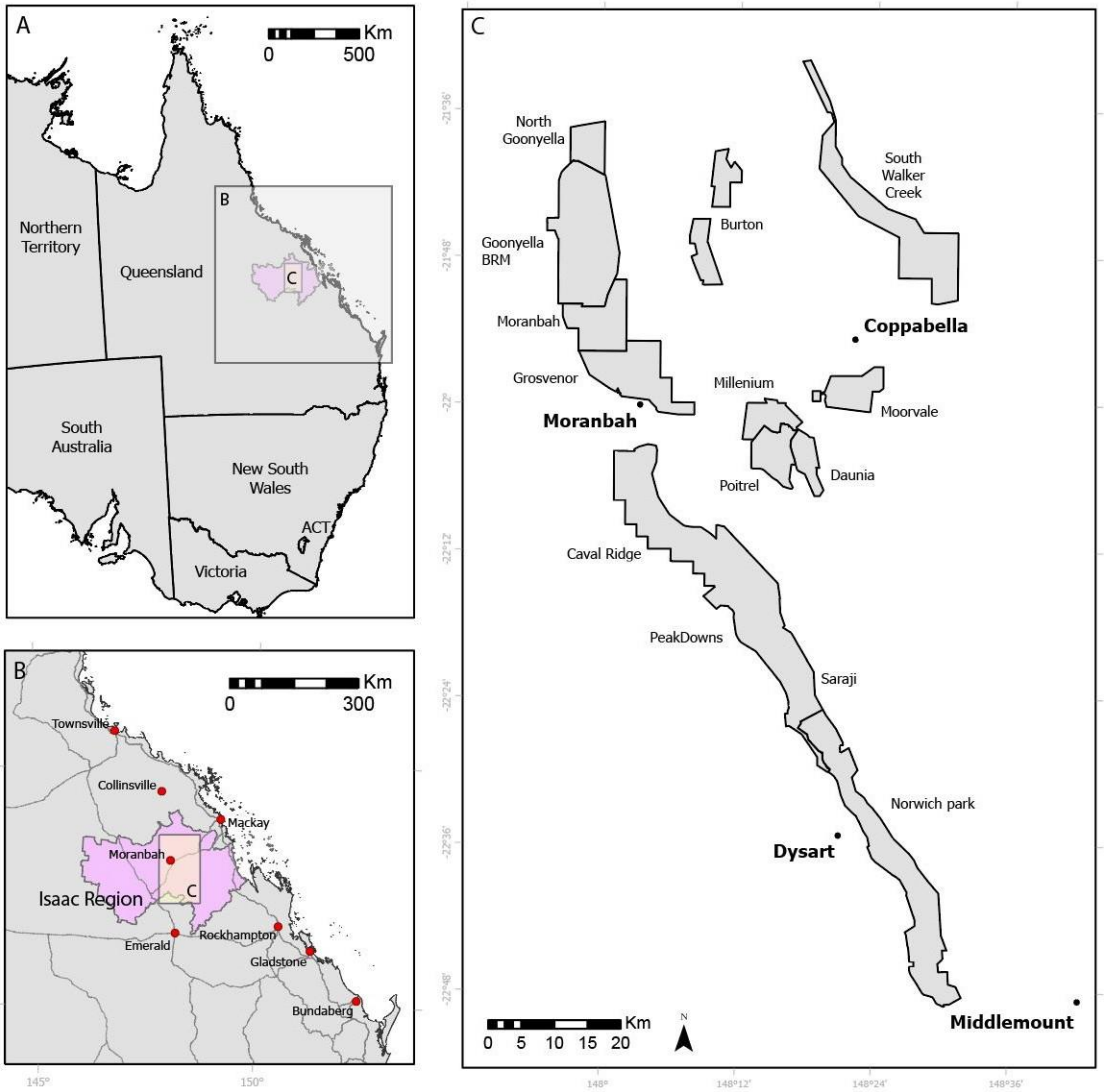
The region contains a cluster of coal mines that are operated under similar conditions and face similar issues. Many of these mines are owned by the three collaborating companies.

Coal mining in the Moranbah region is characterised by a mix of mine owners, operating models, mining methods (including open cut and underground), and operations at various stages of the mining lifecycle, including concept, feasibility, operating, care and maintenance and closed (ceased operation). This project identified the mines and mining projects in the region: 14 are operating mines, five are projects (some in the process of securing approval), one is at conceptual level, three have been placed in care and maintenance and three have ceased operations and are actively planning for closure. Given the number of mines in the region, impacts associated with cumulative mine closures can be expected.

A feature of the region is that most of the underground mines extract coal using mechanical shearers that move horizontally across the coal seam to form a wide cutting face (referred to as “longwall” mining). Self-advancing, hydraulically-powered supports temporarily hold up the roof while coal is extracted. When coal has been extracted, the roof is allowed to collapse. This generally leads to subsidence, whereby the ground level lowers as a result of coal extraction and roof collapse. The impacts of subsidence are well documented and can vary with the location, but broadly, are changes to topography with areas of ponding and alteration of surface water flows. Currently the preferred approach to remediate ponded areas is to reshape the subsidence troughs and re- establish a free-draining landform. However, the ponded areas can provide habitats to flora and fauna in a landscape that has lost many of its ephemeral wetlands. Creation of new pools can make a positive contribution to environmental values. The region presents unique opportunities for innovation in rehabilitation and closure of subsided areas.

Location

The Moranbah region was defined as extending to a 50km radius from the town of Moranbah, at the northern end of the Isaac region, around 200km south-west of Mackay. The location is considered outer regional Australia, according to the Australian Bureau of Statistics’ (ABS) remoteness area classification. The purpose- built mining town was established in the late 1960s as the residential and service centre for BMA’s Goonyella mine. Since then Moranbah has developed into an industrial hub, servicing open-cut and underground metallurgical coal mines, a major coal seam gas project, an ammonium nitrate plant, and light industrial activities. The region is also home to a well-established pastoral community, which primarily undertakes low intensity cattle grazing and some cropping.



Leadership of repurposing

Moranbah Post-Mining Land Use Collaborative Project: Baseline Works is a multidisciplinary study funded by Anglo American, BHP and International Council on Mining and Metals (ICMM), with in-kind support from Peabody.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
Mines	There are many mine operators in the region, including BHP, Anglo American, Peabody and Stanmore	Mine operators can collaborate on design of PMLU options to maximise benefits, e.g. re- establishing biodiversity corridors or protecting riparian and sensitive zones
Neighbouring landholders	Well-established graziers, primarily undertaking low intensity cattle rearing	Development of land management techniques to ensure sustainability of grazing on mined land
Local councils	Isaac Regional Council and Greater Whitsunday Alliance	Participate in developing post-mining vision for the region
State government	Coordinator General Department of Environment and Science Department of Resources	Develop Regional Vision for post-mining future and adapt regulatory frameworks

Traditional owner organisations	There are economic, social, cultural and environmental opportunities (e.g. as would be identified in an 'Indigenous Interests Directory' as described in Section 4.11)
Education providers: Central Queensland University, TAFE, Education Queensland	Develop education and training programs that prepare people for likely post-mining opportunities
Renewable energy companies	Potential renewable energy projects on mined land with re-purposing of mine infrastructure (e.g. power lines, rail, pipelines depending on potential for wind, hydrogen, solar or pumped hydro power)

State of operations

Coal mining in the Moranbah region is characterised by a mix of mine owners, operating models, mining methods (including open cut and underground), and operations at various stages of the mining lifecycle, including concept, feasibility, operating, care and maintenance and closed (ceased operation).

There is no publicly available mine closure data (closure dates, detailed strategies, and action plans), particularly for operations with extensive mine lives. This project reviewed operational life and estimated closure dates for the region's mines, projects and other industrial activities, for the scenario in which the life-of-mine plans were adhered to and there was no impact from commodity price, updates to regulatory framework or other constraints. It showed two potential 'peaks' of mine closure transition: approximately 2040 and approximately 2070.

Closure planning timeframe

Overview from review of available information from about 25 mines:

Date operations began Various, from 1960s onwards

Date operations cease Various, as early as 2020, with one peak in 2040 and a second one in 2070

4.1.2 Steps Towards Repurposing

Key enablers	Key hurdles
Federal government climate change policy	Failure to develop and adopt an effective policy is preventing implementation of innovative solutions (investment in carbon sequestration, development and co-existence with renewable energy projects with smart-grid solutions).
Queensland government	Lack of regional vision and regional plans is preventing implementation of innovative solutions (re-establishing biodiversity corridors, protected horticulture in old mine buildings etc).
Queensland Department of Environment and Science	Adoption of a post-mining land use that is not currently listed in Environmental Authorities will require an amendment. For some PMLU, this might require extensive technical studies.

Regional industry champions	Lack of incentives for mines/companies to set up demonstration projects (e.g. protected horticulture, regenerative agriculture with carbon sequestration).

SWOT of the proposal/project

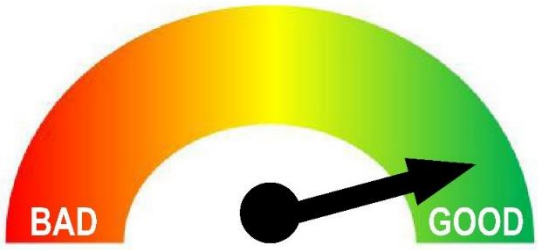
Strengths	Weaknesses	Opportunities	Threats
▪ Local population reports high satisfaction with life, indicating place attachment and willingness to stay after closure ▪ Long standing agricultural industry with well-established stock routes ▪ Extensive infrastructure ▪ High solar radiation ▪ Strong and well-developed links with neighbouring regional councils	▪ Ageing infrastructure with low levels of State and Federal investments ▪ Reduction in ecological value due to historically poor environmental processes ▪ Climate variation with prevalence of back-to-back dry periods ▪ Extensive clearing of native vegetation from various industries ▪ Most land has severe to extreme limitations for cropping and horticulture	▪ Demand for biodiversity and wildlife conversation ▪ Demand for research, learning and innovation in broad scale mine rehabilitation ▪ A green economy – a low-carbon, resource-efficient and socially inclusive approach	▪ Decrease of State and Federal funding support of the region ▪ Fragmented energy policy

4.2 Kidston Clean Energy Hub, Queensland

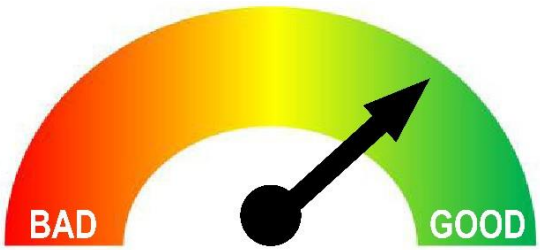
Kidston Gold Mine – former underground and open cut gold mine

Dashboard

Progress to date:



Prospects for success:



What is the vision?

There are growing expectations relating to net-zero emission targets for governments and industry globally. This has resulted in new pressures on the resource sector to improve its carbon footprint performance, as well as contribute to green energy solutions. Factors such as carbon pricing, renewable energy integration, and the social impacts of mining operations have incentivised governments and industry to set carbon neutral targets.

The global mining industry has responded by setting aggressive targets to achieve zero emissions in coming decades, with many mining companies aiming to reach zero emissions by 2050.

The mining industry is therefore seeking pathways by which it can contribute to its own emissions reduction targets, and to drive decarbonisation through the provision of green energy materials. There is potential to extend the use of mining localities to the deployment of renewable energy solutions. The availability of utilities such as power infrastructure, ready access to water, transport systems, accommodation facilities and unencumbered land that often accompanies mine locations makes them conducive to host large scale renewable energy systems.

The Kidston Gold Mine, which ceased operations in 2001, is well suited to the development of multiple renewable energy solutions, namely a combination of solar and pumped hydro. The deployment of renewable energy solutions has already begun at Kidston, with the commissioning of a stage one solar PV array as part of a larger Green Energy Hub complex. Genex is the company responsible for pursuing the Kidston Green Energy Hub.

The Genex Green Energy Hub at Kidston has the potential to serve as an exemplar project on the deployment of large scale green energy solutions to provide zero emissions power on mine sites.

What has been achieved so far?

Genex Power Limited has already delivered a 50MW solar PV system at the Kidston mine. As of December 2021, the full scope flagship project known as the Kidston Clean Energy Hub is in final planning stages, and is undergoing a community and governmental consultation review process. The Genex initiative aims to repurpose the now relinquished open cut gold mine and its facilities into a renewable and alternative clean energy generation facility, including a combination of solar PV and pumped hydro, with potential for future expansion into wind. The locality is serviced by a 132kV power transmission line and a reliable water supply, which were originally utilised by the mine.

4.2.1 Background

Type of mine

Kidston Gold Mine is a former underground and open cut gold mine, and is located in northern Queensland. Gold was first discovered in the area in 1907, and was initially in alluvial form found in gullies leading to the Copperfield River. Once the alluvial gold was depleted, gold was pursued in quartz reefs throughout the 20th century. The mine ceased operations in 2001.

The Kidston mine included the construction of a town and Kidston Dam, as well as open pit and underground mine developments, providing a reliable water supply and electricity connection infrastructure (including a 132kV power transmission line). In recent years the Kidston mine has become the focus of a major development initiative for generation and storage of low emissions energy known as the Kidston Clean Energy Hub. The Hub includes the Kidston Solar Project, which has been built on the flat surface on top of the tailings heap, and a Kidston Pumped Storage Hydro Project facility.

This case study provides a unique example of how mined land, and in particular disused mine infrastructure, earthworks and tailings facilities, can be re-used for the purposes of clean energy generation. A case study into the experience gained during the planning and development of the Kidston Clean Energy Hub can provide invaluable insights into the challenges, opportunities and key considerations when repurposing existing and old mine sites alike to drive transformations in mining economies.

Location

The site for case study, the Kidston Clean Energy Hub, developed on the former Kidston mine site, is located in northern Queensland, Australia. The area is located approximately 280km North West of Townsville.

Leadership of repurposing

Genex Power, the key investor and developer of the clean energy generation infrastructure in the region, along with Queensland Government representatives and ARENA, will be key partners and providers of research information in this project. Aecom will also be involved due to their involvement in preparing the Ministerial Infrastructure Designation Proposal for the expansion project.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
Kidston Gold Mine	The host of the renewable energy hub	Successful commissioning of the Green Energy Hub
Mines	Multiple mines in the vicinity of Kidston Gold Mine, including (but not limited to): • Balcooma Creek • Cumberland • Donnyville • Durham • Lighthouse • Percyville Field • Forsayth/Etheridge Goldfield: Percyville, Mount Hogan, Mount Morgan and Gilberton	Potential clients of low emissions power available from the Kidston Green Energy Hub
Local communities within the vicinity of Kidston Mine	Multiple towns and communities	Potential users of low emissions power available from the Kidston Green Energy Hub
Genex	The owner of the Kidston Green Energy Hub development program	Owner and driver of the renewable energy complex
Aecom	Engineering consultancy	Contributor to the Kidston Green Energy Hib (author of the Ministerial Infrastructure Designation Proposal)

State of operations

The Kidston Clean Energy Hub provides a unique insight into the world's first re-purposing of an old gold mine into a clean energy generation facility, at significant scale. It includes a combination of multiple renewable energy solutions including solar, pumped hydro and potentially wind generation infrastructure.

- **Solar farm:** The Kidston energy hub has already successfully delivered a 50MW solar PV facility that is currently connected to Australia's NEM (National Electricity Market). This solar PV array is underpinned by 20-year Queensland Government Support Deed.
- **Pumped Hydro Power Energy Storage/Generation Facility:** The Kidston Pumped Storage Hydro Project will utilise the two existing mining pits (known as Wises and Eldridge) as the upper and lower reservoirs for the project. The planning for this part of the Hub has been partially completed, and the utilisation of existing mine pits will significantly reduce construction time and cost. Given the significant potential water head differential that the pits offer, and the large quantity of water the pits can hold, the project has the potential to support 2,000MWh of continuous power generation in a single generation cycle (250MW of peaking power generation over a 8 hour period). As there is a legacy power transmission line in place, power generated is expected to be sold directly into the National Energy Market. During off peak periods, water will be pumped back from the lower to the upper reservoir with the pump/ generators acting in pumping mode. This facility is backed by a $147 million government support package.
- **Solar Farm Expansion:** The expansion of the existing solar photo voltaic facility to another 250MW Solar Project, with the ability to integrate with Kidston Pumped Storage Hydro Project to power the pumping cycle. This will provide further direct power capacity, and will provide an additional source of renewable energy to recharge the pumped hydro system. This solar expansion project will be one

of the largest solar projects under way in the southern hemisphere, equivalent to meeting the needs of almost 150,000 homes and offsetting approximately 650,000t CO^2 annually.

The Kidston Clean Energy Hub case study provides an example of successfully transforming a disused mine site into a large scale clean energy facility. The project will assist in assessing, planning, engineering and promoting the repurposing of other mine operations towards zero emissions operations, and is an excellent case for inclusion into CRC TIME research.

Closure planning timeframe

The Kidston Gold Mine started in 1907, and experienced multiple disruptions to operations throughout the remainder of the 20th century. The mine ceased active extraction operations in 2001, and remained in care and maintenance status until 2015/2016, at which point the Green Energy Hub complex plan was initiated by Genex. In 2017 the 50MW solar PV plant (stage 1 of the solar PV system) was commissioned.

The expansion of the complex is currently undergoing a consultation process via a Ministerial Infrastructure Designation Proposal to determine an approval to continue its development.

4.2.2 Steps Towards Repurposing

Key enablers	Key hurdles
Positive community feedback	Negative feedback/concerns
Government funding/subsidy	Engaging the right government connections
General mining industry support	IP hurdles and lack of information sharing
Identifying low emissions power users	Limited interest/high cost of low emissions Hub power

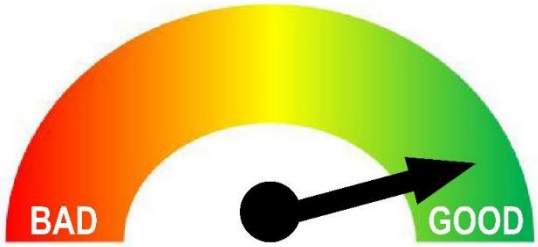
SWOT of the proposal/project

Strengths	Weaknesses	Opportunities	Threats
▪ Project initiated and stage 1 commissioned ▪ Planning of further stages advanced ▪ Aligned with key industry need for emissions reduction ▪ Government support	▪ Heavily commercial ▪ Project delayed (started in 2017) ▪ Mine already ceased operations (closure process not in scope) ▪ Late entry into initiative	▪ Generate industry standards/roadmaps ▪ Leverage key learnings ▪ Unique multiple renewable energy scenario (solar, pumped hydro and maybe wind) ▪ Leverage government funds	▪ Project in progress – is there scope for CRC TiME involvement? ▪ Engineering consultancies take research opportunities ▪ Project kept in-house without sharing experiences

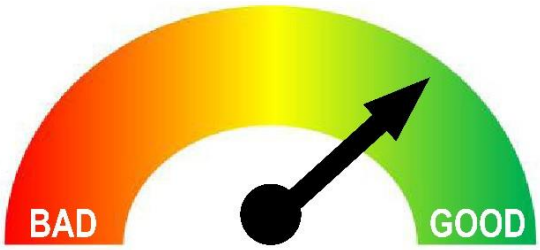
4.3 Lake Kepwari: Collie coal mine, Western Australia

Dashboard

Progress to date:



Prospects for success:



What is the vision?

The overarching vision is to transition the Collie locality, dominated by coal mining for more than a century, to a "sustainable economy with a more even spread of employment across a greater range of industries" (South West Development Commission 2020 p 3), reducing the reliance on one sector. An important part of this vision is to relinquish rehabilitated mining assets over an extended period, as they become redundant and/or exhausted, for a variety of uses but particularly to promote the region's tourism potential.

What has been achieved so far?

The standout achievement to date has been the re-purposed deep, coal mining pit that was ultimately relinquished back to government and the Collie community by the mining company in 2020 as Lake Kepwari a "world-class aquatic playground", as shown in Figure 2.

Figure 2: W05B coal mining pit to Lake Kepwari 1996-2020

4.3.1 Background

Type of mine

The pit lake was part of a larger coal mine site, which produced black coal for Western Australian domestic and industrial power. Mining at the site where Lake Kepwari is now situated began over 50 years ago in the

1970s and ended in 1996. In 1990, the south branch of the Collie River was diverted around the open cut workings to allow access to additional coal reserves beneath the river within the W05B mine pit – later known as Lake Kepwari. The environmental regulatory agencies were reticent to leave W05B as a water-filled void, instead wanting to fill it with mining waste. Agreement to fill the void with water was finally approved in 1997.

When the mine owners announced plans to withdraw from underground mining in the early 1990s, state and community organisations earmarked the redundant assets, particularly the large void and pit lakes for creative rehabilitation and re-use. The aspiration was to rehabilitate the void to a standard that would go far beyond the basic aims of the creation of a safe and stable land form, to a public asset that would rival Wellington Dam, 45 kilometres west, and provide new small business opportunities for the town, thus supporting the community through local business diversification.

However, it was a long and expensive process to change the closure strategy from a disconnected lake and the transition from a mining void to a recreational lake with sustainable ecosystems fit for human use and able to support aquatic species suitable for human consumption was an ambitious plan with multiple challenges. A key obstacle was the mining void would take 100 years to fill with water naturally under the approved 1997 Mine Closure Plan for Lake Kepwari as a "closed catchment lake". This would have also resulted in poor water quality in the lake due to acid mine drainage (AMD) impacts on the groundwater and from the void itself, limiting the recreational and environmental values of the lake. It was determined that if the lake was able to be rapidly filled, the water quality would be improved and the lake able to be utilised within a more acceptable timeframe than if it filled naturally.

A series of culverts and valves were installed between the lake and the Collie River diversion channel following the issue of a Surface Water Licence which permitted the mining company to divert water into the mine void during high seasonal flows allowing the lake to reach 32 × 106 m^3, with a maximum depth of around 65 m, and a perimeter of 5.4 km and surface area of 1.0 km (McCullough & Evans 2021) in 2004. However, the quality of the water was not optimal with a low pH and elevated concentrations of some metals and metalloids likely reducing end use opportunities, which held little promise as a future recreational community asset.

Another conundrum was reinstating the natural flow of the Collie River through the proposed Lake Kepwari. Initially, the rehabilitation plan was to leave the diversion in place, with the diverted river running adjacent to the lake and seasonal topping up of the lake levels when required. Regular flushing of the lake was going to be limited, with the likelihood of regular eutrophication. Fortuitously, nature intervened and in 2011 with unseasonal high rainfall, an unexpected over-topping and river breach into the lake prompted a re-think of the original strategy. The overtopping and river breach caused river flow-through into Lake Kepwari, resulting in rapid and enhanced flushing which substantially improved water quality and ecosystem values (McCullough et al 2012).

While the river breach in 2011 was initially viewed as a disaster, the environmental benefits of rapid flushing were documented and monitored. The long-term outcome of the regular monitoring and scientific studies subsequently influenced changes to the rehabilitation plan. Regular monitoring found that the alkaline river water neutralised the low pH during regular flow-through (rain events) and biological processes, especially algal growth during the warmer months with less flow-through contributing to maintenance of neutralised water year-round (Lund & McCullough 2009). Government regulators were slow to accept the revised Closure Plan, demanding a large amount of data and records to show compliance with the completion criteria, with no appetite for a 'snapshot' of how the area was performing at the time of surrender, but instead insisting on historical records dating back to pre-mine closure in the early 1990s, which ultimately had little relevance for the status of the lake or the future plans. The company and its contractors were often frustrated by a sense of the 'goal posts often in a state of flux', especially towards relinquishment date.

There were different interpretations of exactly what was needed to be achieved and demonstrated to meet the completion criteria.

Final approval for the permanent flow-through of the Collie River was granted in November 2018 and civil works, undertaken by local contractors, were completed in June 2019. Using and applying the knowledge from the river breach was pivotal. Flexibility in environmental engineering, opportunistic responsiveness to natural rain events and significant investment proved an important combination.

As this was only a partial surrender, (other parts of the mine are still operational), a boundary needed to be determined and agreed upon relinquishment of the lake area. The state was only interested in the lake and the areas immediately adjacent, (for car parks, camping facilities etc.). It was careful not to have any additional ex- mining areas. Consequently, the boundary of the Lake Kepwari area is relatively complex, resulting in challenges for physically delineating the surrender boundary (which was a requirement of the process).

The formal relinquishment of Lake Kepwari, a total of 220 hectares, including 120 hectares of rehabilitated and revegetated land around the lake, occurred in December 2020. The state government was ultimately satisfied that the lake was not only safe but that it was sufficiently healthy for active recreation including swimming, boating and fishing. Fish and crustaceans have been successfully re-introduced and monitoring suggests they are thriving. Lake Kepwari has also been incorporated into the Collie River Waugal Aboriginal Heritage site, which includes the entire Collie River system.

Lake Kepwari took 25 years of technical and supporting studies, consistent monitoring and reporting to provide an evidence-based framework to demonstrate the successful transition of highly degraded mining land to a safe, usable, aesthetically attractive water feature that meets stakeholder-agreed closure objectives. However, for Lake Kepwari to reach transformative status, it required substantial cash and in-kind injections from a range of government agencies.

Location

Lake Kepwari (a Nyungar word for ‘playing with water’) is 15 minutes’ drive east of the town of Collie, in the south west of Western Australia. It is 180 km from Perth and 60 km inland from Bunbury, the largest regional city outside of Perth. The Collie valley is densely timbered by jarrah forest and the Harris and Collie rivers flow through it. The area has undulating hills with quality agricultural land and recreational reserves dotted throughout, the most important being Wellington Dam, a popular recreational location for bush walking, swimming, fishing and boating.

Leadership of repurposing

The long-term vision for a recreational asset such as Lake Kepwari dates back to the 1990s when the idea was spearheaded by a local former mine employee, Mick Murray. Mr Murray was keen for Collie to be much more than a blue collar coal mining community and wanted the natural beauty of the valley to drive economic and social diversification. In the 2001 state election, Murray successfully contested the local seat and the vision for the future transformation of Collie and Lake Kepwari were key electoral ambitions. Despite local support and an unwavering commitment, Murray gained little traction as a member of the government opposition.

In 2017 there was another state election and Murray was appointed Minister for Sport and Recreation giving him a platform to drive the Lake Kepwari vision. Simultaneously, Cabinet also ratified a whole-of-government approach to the transformation of the local economy away from a dependence on coal to more diversified service-oriented industries.

Local government leadership also played an important role. Their commitment to the vision for the repurposed pit lake was consistent for more than two decades. As a town that has traditionally relied on mining and power generation, the Shire of Collie is embracing the opportunities that come from new business ventures associated with the tourism potential of Lake Kepwari.

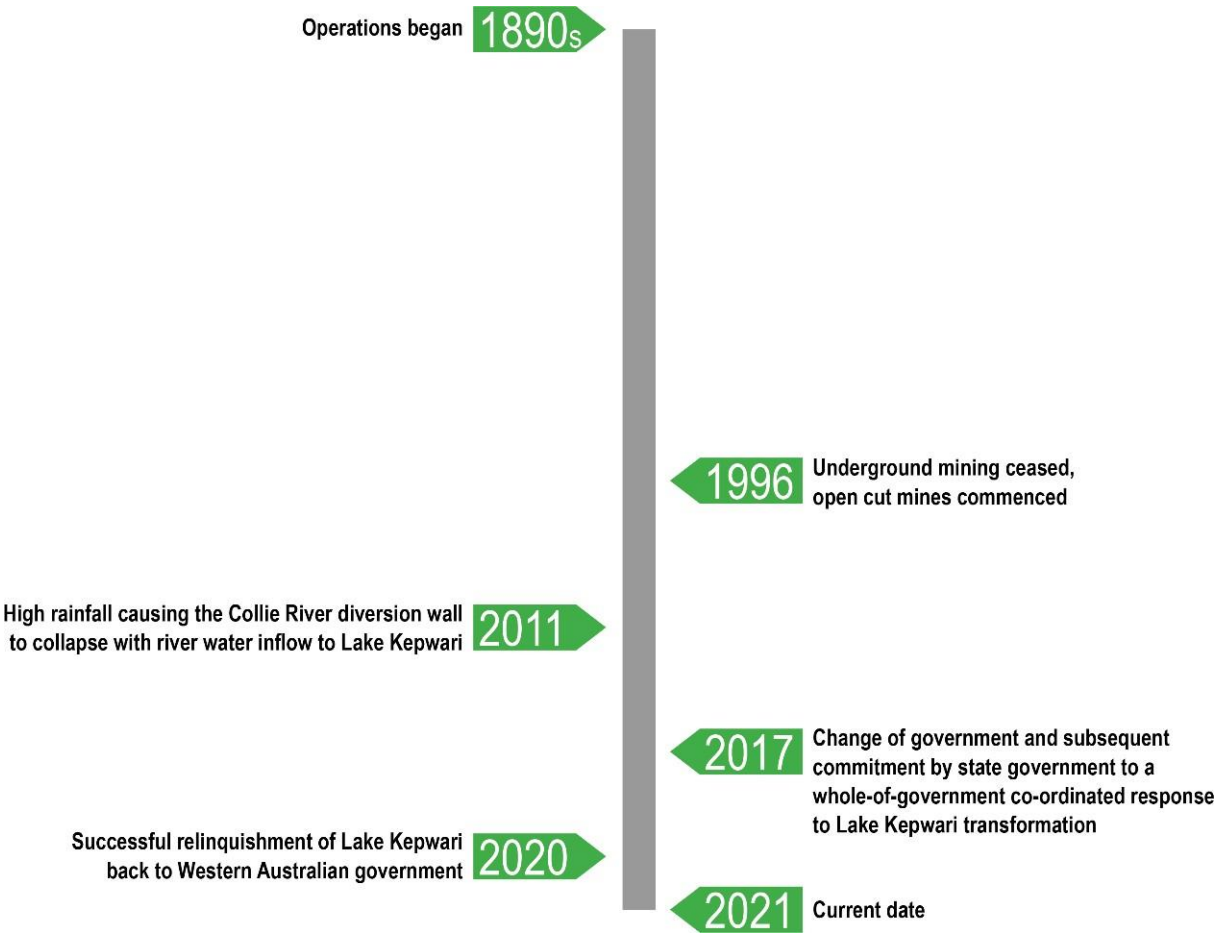
Lake Kepwari became a showcase for progress. Based on business case projections, it was expected that an investment in nature-based tourism using Lake Kepwari as the centrepiece, would attract ~22,000 overnight stays and 37,000 day trip visitors per annum to the town (Dept of Jobs Tourism Science and Innovation & Development 2020). Local and regional government agencies have assisted, through state government regional development grants, with the installation of important tourism infrastructure such as a swim beach, picnic areas, campground, toilets, dual lane boat ramp and jetty, and parking bays for 85 boat trailers and 65 cars. Upgrades to the entrance road, a new bridge over the Collie River and signage throughout the area has turned the area into a water sports landmark (South West Development Comm 2021) with a further $10 million earmarked to upgrade integrated walking trails along the Collie River and Wellington Dam (South West Development Comm 2020).

The relinquishment of rehabilitated mines is uncommon, and without strong, committed political leadership driving the initiative, regulatory agencies are risk averse, hesitant to streamline processes or drive innovation.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
Premier Coal	Coal mining company	Owner of the coal mining assets
Western Australian state government	A range of government departments	South West Development Commission Department of Planning, Lands, Heritage Department of Primary Industries, Regional Development Main Roads Department of Water, Environmental Regulation Department of Jobs, Tourism Science and Innovation Development WA Energy Policy WA Western Power
Shire of Collie	Local government authority	Facilitating community meetings Co-ordinating local grants Consistent commitment to the vision
Local business community		Re-orienting local services to support emerging tourism offerings
Collie education organisations		Providing skills development for new industries

State of operations

Lake Kepwari was relinquished in November 2020 and the Western Australian Department of Biodiversity, Conservation and Attractions has taken back the asset and manages it as a tourist attraction. Its popularity as a recreation drawcard has grown exponentially with each school holiday. Throughout the year, local accommodation venues have reported consistent growth in patronage and increasing interest in other activities and attractions in the locale, such as the Collie town murals and the walking trails book-ended by Lake Kepwari and the Wellington Dam.



Closure planning timeframe

4.3.2 Steps Towards Repurposing

Key enablers	Key hurdles
Local community and political support	Risk averse regulatory agencies
Strong, committed state government	Lack of clear guidelines and streamlined processes
Company willing to respond to environmental opportunities	
Company commitment to the vision	Cost of regulatory demands and historical evidence

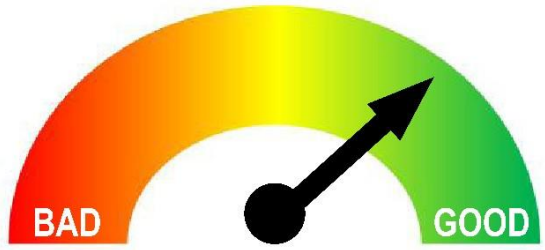
SWOT of the proposal/project

Strengths	Weaknesses	Opportunities	Threats
▪ Strong community support ▪ Strong political support ▪ Exemplar of innovative mine closure strategy	▪ Highly bureaucratic process that was not responsive to evidence or innovation	▪ Flow on business opportunities ▪ Complements other nature-based local assets	▪ Cost ▪ Risk averse regulatory agencies ▪ Poorly defined closure processes

4.4 The FAWNA Inc. Wildlife Hospital and Kaatijnup Biodiversity Park, Capel, Western Australia

Dashboard

Progress to date:



Prospects for success:

Under existing tenure (SF), this dial is more to the left, under an alternate tenure (Reserve, UCL), this dial will be more to the right

What is the vision?

The vision is to establish a biodiversity centre, the Kaatijinup Biodiversity Park (KBP). KBP will have bespoke, specialised wildlife veterinary services and state-of-the-art training facilities for the care and recovery of endangered wildlife and habitats, where researchers, local Aboriginal wildlife carers and rangers, volunteers and DBCA wildlife officers are co-located. The location of the site, equi-distant from two significant south west towns, and adjacent to a national park, would enable the restoration of key habitat for endangered species and enable breeding programs, releasing rehabilitated animals into the nearby tuart forest and monitoring their health, breeding and mobility. Local endangered species include the Western ringtail possum, the southern brown bandicoot and Baudin's and Carnaby black cockatoos. A bespoke veterinary hospital will provide services for the health and treatment of native wildlife while also providing research and specialist training opportunities. The veterinary school at Murdoch university has been undertaking research in the Capel wetlands for three decades and this facility will guarantee ongoing access for monitoring and treatment of native fauna.

To help defray the operational costs of the KBP, separate camping and glamping facilities, a function centre and cafe-restaurant will be developed, a range of complementary visitor experiences (e.g. bird hides, walk/bike trails, picnic areas, animal viewing/petting areas, and interpretive – educational displays), offering revenue- generating capacity. A veterinary hospital will also contribute to operational income.

The vision is for the south west region of Western Australia to gain a fit-for-purpose wildlife rehabilitation and protection facility that will help consolidate its reputation as biodiversity hotspot and a conservation-environment focused destination.

What has been achieved so far?

The land was previously a combination of pine plantation and agriculture, with patches of native vegetation before mineral sand mining commenced in 1971. Mining excavations intersected the water table creating large, deep lakes of permanent water. Over time, these lakes developed typical wetlands ecologies presenting an advantageous post-mining land use oriented to nature based activities. The mining company rehabilitated the lakes with water plants, grasses and trees, and in 1986, the Wetlands Centre was established as a research and education site, later winning several State and national landcare awards. In 1994, facilities (including a large building, composting toilets, car park, five bird hides, and nine kilometres of footpath, three boardwalks and eight pedestrian bridges) funded by the company were constructed to cater

for public access to the Wetlands Centre. The Wetlands Centre was closed in 2008 but the infrastructure remains.

Since 2009, three of the lakes on the Iluka-owned part of the Wetlands have been used by the Water Corporation for its Capel Wetlands Enhancement Project. This is complementary to the KBP plans.

Currently, the site is being rehabilitated in accordance with the Mine Closure Plan (MCP), last updated and approved in 2020 under the *Mining Act 1978* (Mining Act) by the Department of Mines, Industry Regulation and Services (DMIRS). In the meantime, with permission from Iluka Resources and Department of Biodiversity, Conservation and Attractions (DBCA), FAWNA Inc, (registered with DBCA as a wildlife rehabilitation centre), established the 'Possum Finishing School', a possum rehabilitation facility, on approximately one hectare of the site, using some infrastructure from the now closed Wetlands Centre and additional plant and equipment from their own resources.

North of the intended KBP site, the area previously mined has reverted to agricultural production, although the land remains under mine license. Although responsibilities to the state government, under the Mining Act (1978), have not been fully acquitted and the land has not been formally relinquished, hand back has been formalised with the land holders, most of whom are the farmers currently grazing the land. The status and current use of this land presents ambiguities for the mining company; transition of mining land for agricultural purposes with management of the land by the private sector does not present concerns for either the company or the DMIRS. However, DBCA are resisting the proposed KBP land use planning as part of the closure plan development, inferring that there should be no land use planning until post relinquishment. DBCA routinely resist taking back land through land swaps for development and offsets due to the cost of management and long term maintenance and restoration of public land with few opportunities to financially recoup the costs. For the KBP proposal, DBCA are seeking a mechanism that guarantees Iluka's closure obligations persist while alternative land uses are developed and progressively implemented as part of the rehabilitation process.

Currently, there is no regulatory framework that provides DBCA with that comfort.

4.4.1 Background

Type of mine

The case study site was a very rich mineral sands mine known as the South Capel Mine. Ilmenite, zircon and rutile were the principle minerals mined; ilmenite being an important ore of titanium. Established in the 1950s, mining approval was granted in 1968 and approximately 185 of the 284 hectares of the State Forest was mined. The site's resources were exhausted by 1981 when this part of the mine closed.

Location

Land tenure of the proposed KBP site is complicated by a mining lease, mine site rehabilitation processes and a mix of crown and freehold land. The case study site is a 319 hectare parcel of land, comprising a mining lease on 284 ha of State Forest (crown Land) and an adjoining 35 ha of freehold land owned by Iluka Resources Ltd. The site is part of a larger, Iluka minerals sands mine site currently in a closure phase, located five km south of the town of Capel, 200 km south of Perth in the south west of Western Australia. The case study site also incorporates 43 hectares of the rehabilitated Capel wetlands, which are a legacy of the mineral sands mining operations.

Leadership of repurposing

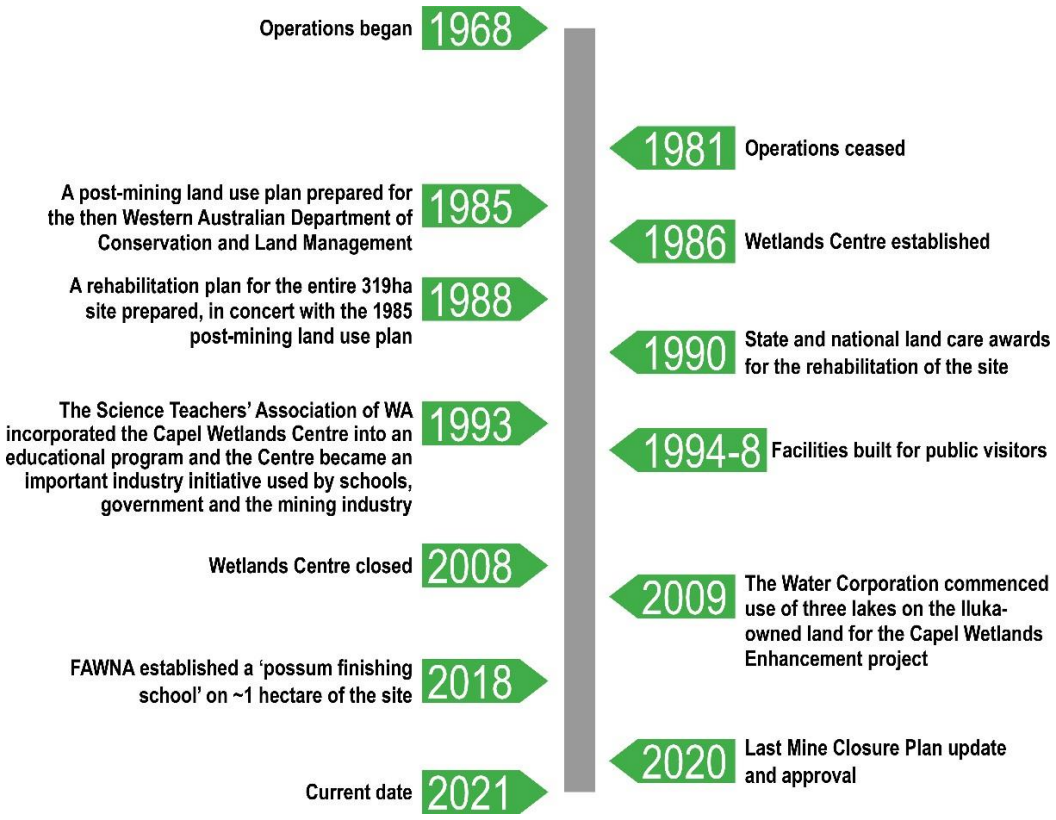
The vision for the repurposing of this site has been developed by FAWNA Incorporated (Inc), with in principle support from Iluka Resources Limited (Iluka) and the Shire of Capel. The Shire of Capel is keen to drive the KBP plans as part of the Shire's overarching nature based tourism strategy but it has no resources to own or manage the site.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
Iluka Resources Limited	Iluka Resources Limited, mineral sands mining and processing	Current mining lease holder wants to fulfill closure obligations and relinquish land for post-mining purposes. Iluka is collaborating with FAWNA Inc on the proposal and Master plan
FAWNA Incorporated	A not for profit organisation dedicated to the care, rehabilitation and protection of native wildlife and ecosystems	Proposing a biodiversity facility incorporating wildlife rehabilitation services, education facilities and separate camping sites. FAWNA Inc is working with stakeholders to secure tenure to the site and develop a Masterplan
Department of Biodiversity, Conservation and Attractions (DBCA)	Government department responsible for eco-system management and regulatory enforcement	Monitoring mine site rehabilitation and end user approvals for Mine Closure Plans. Oversight of Western Australian Conservation and Land Management Act (1984) and lands in the conservation estate. The crown land currently under Mine license will ultimately revert to DBCA. DBCA has limited resources for additional rehabilitation of mining lands
Department of Mines, Industry	The government agency responsible for compliance of approved mine closure plans, including rehabilitation and	A formal written acknowledgement from DMIRS that rehabilitation obligations pertaining to the Mining Act

Regulation and Services (DMIRS)	closure obligations under the Western Australian Mining Act (1978)	and closure outcomes and completion criteria as outlined in the approved MCP have been achieved will lead to relinquishment of land back to former land owners or custodians (including DBCA)
Wardandi Traditional Owners of the Ngoongar nation	The Wardandi elders are part of the Native Title Representative Body, the South West Aboriginal Land and Sea Council Aboriginal Corporation (SWALSC)	The recently agreed South West Native Title settlement formalises Traditional ownership of large tracts of land including land currently under the management of DBCA. Representatives of Wardandi take a keen interest in the future of the KBP site and future ecosystem restoration and rehabilitation activities. Endangered wildlife are important totems for Aboriginal people
Water Corporation	A state government agency using the Wetlands as a showcase for treated effluent applications: The Capel Wetlands Enhancement Project	Treated effluent from the Capel Wastewater Treatment Plant is piped to the Iluka-owned Wetlands to improve the biological and ecological productivity of the lakes by overcoming their poor nutrient status, in particular low phosphorus levels
Shire of Capel	The local government authority within which the KBP is located	The Shire is keen to develop nature-based tourism and capitalise on the nearby Tuart National Park
Wildlife volunteers	Local veterinary practitioners and local wildlife rehabilitation groups and organisations	There is no dedicated wildlife hospital in the south west region, despite considerable demand due to rapid urbanisation, industry growth, encroachment of regional infrastructure and clearing of natural habitat of native wildlife. Commercial veterinary clinics in the South West are unable to provide sufficient low cost / no cost support to native wildlife. Other wildlife rehabilitation groups have closed due to ageing volunteers, increased costs of licensing and operation and poor or outdated infrastructure

State of operations

The mine is now closed and rehabilitation is progressing, in accordance with the agreed Mine Closure Plan.



Closure planning timeframe

4.4.2 Steps Towards Repurposing

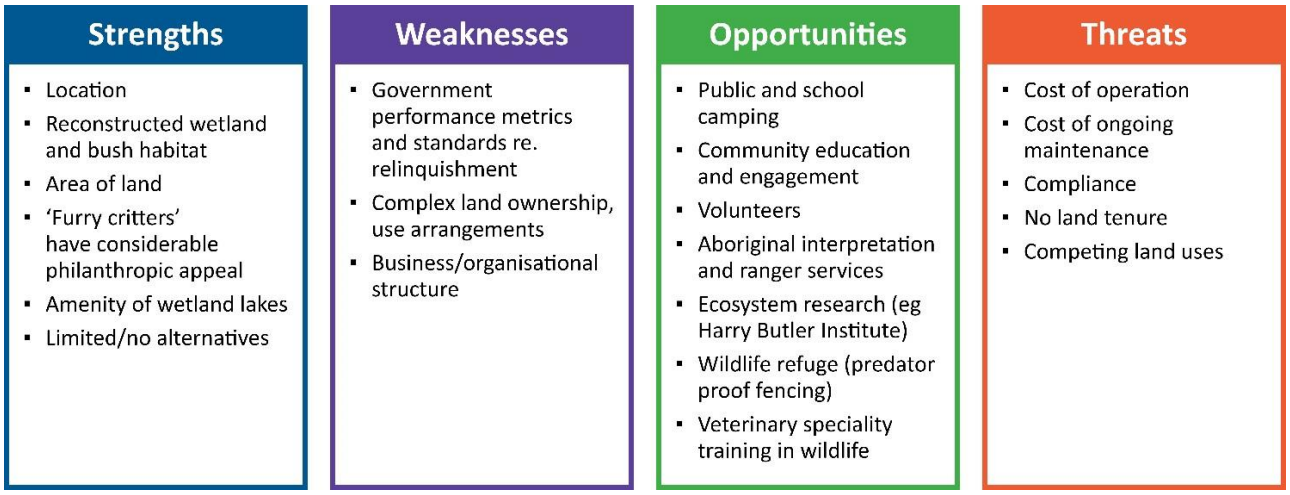
Iluka Resources is keen to fulfill its closure obligations and relinquish the land, in accordance with the agreed MCP (2020). Conditions under the Mining Act require that the MCP be updated in 2023, providing the opportunity to evaluate and formalise alternate land use scenarios.

FAWNA Inc. is seeking long-term tenure of the site. Security of tenure is important for a number of reasons, but most particularly for the investment of expensive infrastructure for the veterinary hospital and the camping and commercial outlets, which will underwrite the ongoing maintenance of the KBP. Options for long-term use of the state forest portion of the site could include a lease under the *Conservation and Land Management Act (1984)* although this option seems improbable based on DBCA responses to date. There is also the potential for an excision from State forest into a Crown reserve vested in an agreed management agency (such as the local Shire), or freehold land which would involve statutory processes and approvals. Conversion of crown land to freehold land requires excision from State Forest with the support of the Conservation and Parks Commission and the Minister for the Environment. This would then be followed by approval of a Parliamentary (joint sitting) process, before the 284ha of crown land could revert to unallocated crown land, at which time FAWNA Inc. could apply to the Minister for Lands for long term leasehold (or freehold title).

Under the *Forest Management Plan 2014-2023*, excisions from State forest require compensation for the loss of State forest. The State also requires comprehensive feasibility and business planning to determine long-term funding and sustainability. These are currently being undertaken.

Key enablers	Key hurdles
Community and local government support for the KBP and a fit-for-purpose wildlife rehabilitation facilities	Land tenure for an entity such as KBP requires long-term certainty. There is considerable complexity with limited encouragement from government to change
Identified and documented endangered status of several local wildlife and flora species	Performance metrics and standards, established by government authorities, are unclear. DBCA in particular is wary of taking back land that may have yet-to-be identified liabilities
Optimal location between two large towns, with excellent road access and adjacent to a national park An opportunity for the company to successfully relinquish part of the mine site and assist in the repurposing of the land The Wetlands Centre demonstrated the success of a similar facility to that planned for KBP	A reliable income stream to maintain and services to KBP

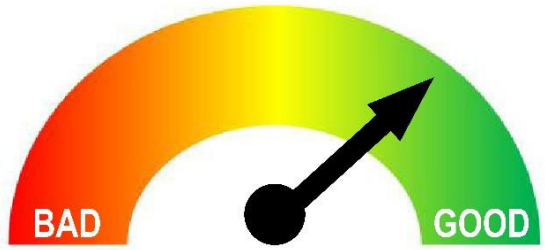
SWOT of the proposal/project



4.5 Hannan's North Tourist Mine, Kalgoorlie, Western Australia

Dashboard

Progress to date:



Prospects for success:

In terms of progress, the dial has moved back and forth over the years. On the positive side, it continues to operate, but the significant negative dimension is the ongoing need for subsidy.

Prospects for success are also very uncertain. If the necessary funds can be raised, the site may be moved and the city's vision realised. Stakeholders believe any new site will need a comprehensive business plan, with market-focused leadership. Substantial funds are needed, however, and previous fundraising efforts have been unsuccessful.

What is the vision?

Hannan's North Tourist Mine has evolved many times over the years. The original attraction opened as Hainault Tourist Mine in 1972. The original vision was to create a traditional gold-mining museum experience for tourists, representing Kalgoorlie-Boulder's gold mining heritage. Hainault Mine Site was reincorporated back into the Superpit and a new site chosen at Hannan's North. The move to Hannan's North also linked the site to the Australian Prospectors and Miners' Hall of Fame (APMHF), a registered charity, which was based on the same site and operated the attraction from 1992-2011. The APMFH building was recently sold and now functions solely with an online presence (http://www.mininghalloffame.com.au/) to commemorate key contributors to Australia's mining heritage.

The current vision for Hannan's North Tourist Mine varies depending on the stakeholder. The mine owners, Kalgoorlie Consolidated Gold Mine (KCGM) (incorporated into Northern Star in 2021), intend to reopen the mine and the City of Kalgoorlie-Boulder has been investigating alternative locations for the tourist attraction. A popular vision is to relocate the tourist mine to the Loopline Park in Boulder. This incorporates the site within the tourist precinct in Boulder, close to other Gold Rush-era attractions.

4.5.1 Background

Type of mine

Hannan's North is an historic gold mine.

Location

The attraction is currently based at Hannan's North, approximately 3km outside of Kalgoorlie-Boulder city centre. There is a regular tourist bus but there is debate as to how far the location outside of the centre has been a limitation in attracting tourists. There is a proposal to move the site to the Loopline Park, to form part of a tourist precinct with nearby Burt Street within Boulder's historic city centre.

Leadership of repurposing

The leadership of the Hannan's North attraction has changed several times over the years. The original operation at Hainault Mine was established by a local group of enthusiasts who engaged volunteer miners to conduct tours at the site. The new operation at Hannan's North was owned and operated from 1992-2011 by the Australian Prospectors and Miners Hall of Fame as noted above. In 2011, APMHF was forced to close due to financial problems. In 2012, the lease for the site was taken over by KCGM, who employed a tourism team to reopen the attraction in 2013. If a new attraction using the site's assets is established in Boulder, it is likely it will be operated either by the local city council or an independent entity, which could be commercial or not-for- profit.

The current ownership of the attraction involves a number of stakeholders. The land on which the mine site is situated is leased from the WA State Government; the mine site and equipment are owned by KCGM; and an estimated 60% of the artefacts belong to the WA Museum. The city's proposal is to move the attraction to the Loopline Park, currently home of the Golden Mile Loopline Railway Society, which received WA State Government funds to restore the Goldrush-era Loopline Railway. Unfortunately regulations regarding railways changed during the restoration process and the funds had to be returned. The Railway is currently closed.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
KCGM/ Northern Star	Gold mining company	Gold mining and community relations
Western Australian Museum	WA state museum	Research and education based on WA's natural and social heritage
City of Kalgoorlie-Boulder	City council	Create mining based tourism attraction at Loopline Park
Australian Prospectors and Miners Hall of Fame Board	Board of Directors for registered charity	Commemorating Australia's mining heritage
Golden Mile Loopline Railway Society	Voluntary group who oversee Loopline Station and Railway Line, the proposed site for the new attraction	Relocate Hannan's North Tourist Mine to Loopline Park

Community	People who live in the Goldfields and have: 1) a strong interest in what is happening with the Super Pit and mine life; and 2) Access/ed the Hannan's North for events etc, take their visitors	Enduring economic potential of the region and their quality of life

State of operations

Hannan's North Historic Mine is currently operating as an attraction, however, the future of the site is uncertain. The attraction has been operating at a loss for several years and KCGM wish to incorporate the mine site itself into the Superpit, an operational gold mine.

Hannan's North Tourist Mine Site comprises of four components:

- Hannan's North surface attractions
- Hannan's North underground tour – currently closed
- The Australian Prospectors and Miners Hall of Fame – currently closed and the building sold to a private individual.
- The Chinese Garden.

There are free tours of the Superpit leaving from the site. According to interviews, the three main attractions for tourists visiting Hannan's North are the underground tour, the gold pour and gold panning. Of these, only the gold panning is always available to visitors. The gold pour only takes place at busy times such as school holidays.

The current adult admission price for a self-guided tour of the surface attractions is $15. A report on the future of the attraction conducted by Price Waterhouse Coopers (PWC, 2019) and commissioned by the City of Kalgoorlie-Boulder reviewed the prices of underground mine tours currently available in Australia, which varied between $20 and $199. All these tours are in former operating mines. The underground tour at Hannan's North was unique in WA and there is still no underground mining tour anywhere in the state. There are significant health and safety challenges, as well as insurance implications in touring a former operating mine. Some stakeholders have proposed creating an artificial underground mining tour experience to address the health and safety concerns. When they were open, underground tours were given by volunteers, who were former miners, which provided authenticity.

While Hannan's North Tourist Mine has continued to operate, it has made a financial loss each year and has been subsidised both with up to $1m in cash and in kind support by KCGM (PWC, 2019). The largest cost by far is staffing and according to some stakeholders, the exhibits need maintenance. It is debateable whether KCGM wishes to continue to operate a tourist attraction since tourism is not a core business of mining companies.

KCGM does permit tours of the Superpit, which are a popular experience for tourists visiting Kalgoorlie-Boulder. The Superpit tours are not run by KCGM but are outsourced to an external operator.

Tourist numbers to Kalgoorlie had been steadily declining since 2010 but pre-COVID there was an increase especially with intrastate visitors. These tourists were primarily traveling for business and were mostly individual tourists. The PWC report states that visitor numbers to Hannan's North have been steadily increasing (pre- COVID) since 2013. PWC report shows that the attraction's income was split fairly evenly between merchandise, admission ticket sales and tour ticket sales. The largest growing source of income was merchandise. School groups are a major market for the attraction and it has employed an education officer at times. The attraction also advertises events, including weddings, which are available in the Chinese Garden. The attraction is open Sunday to Friday.

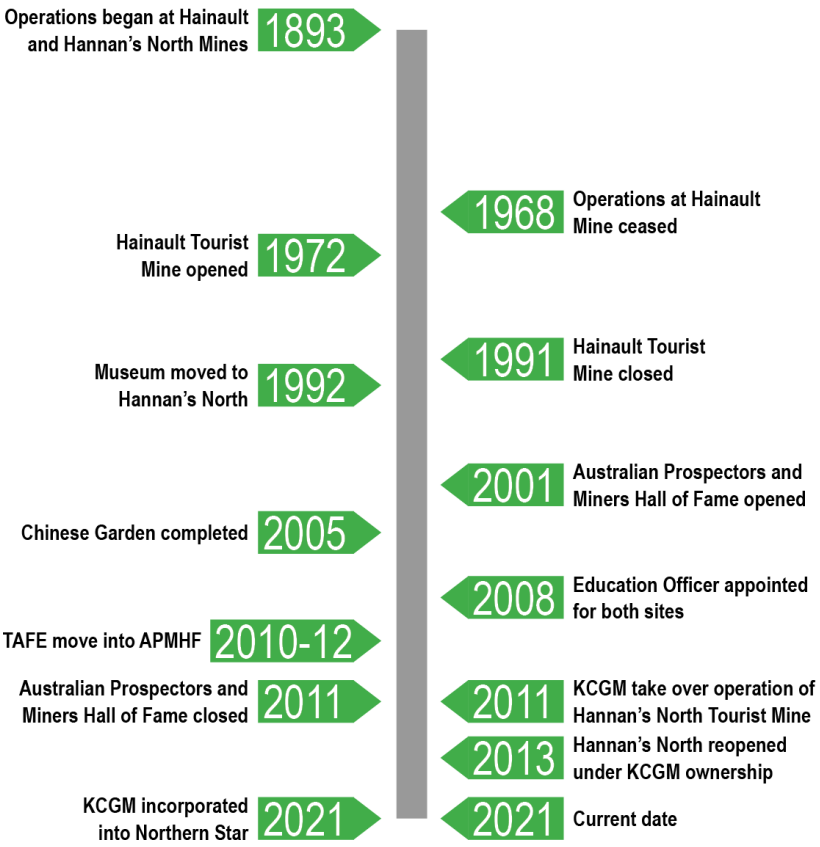
One stakeholder commented that Hannan's North is not a remarkable mine (though it is a genuine goldmine, unlike some other gold mining attractions in Australia), it was just conveniently located when the original tourist mine had to close. Paddy Hannan, however, was one of the three original prospectors to discover gold near Kalgoorlie in 1893 so the brand name may have value.

The PWC report identified four options for the future of Hannan's North Tourist Mine and conducted a feasibility and financial analysis of these alternatives. The report forecasts revenue increases for the site going forward based on reopening the underground tour. Financial analysis, however, recommends closing the mine site attraction. The second best performing financial option is to transfer the attraction to a new operator and combine the experience with Superpit tours but remain at the current site. As noted above, Superpit tours are currently available from Hannan's North.

The future plans for Hannan's North Tourist Attraction are uncertain. The preferred option for the City of Kalgoorlie-Boulder is to move the attraction to the Loopline Park in Boulder and resolve future operations and ownership of both Hannan's North and APMHF (City of Kalgoorlie-Boulder, undated). There are, however, issues regarding land ownership and use for the Loopline Park, which need to be resolved. Stakeholders have commented that they are unclear whether it is better to close the current mine attraction and start again or move some of assets to the new site. KCGM/Northern Star have continued to support the operation of Hannan's North while new plans for the attraction are developed.

Key learnings from this case study are about the importance of a sustainable funding model for any post-mining tourist attraction as this has been the greatest challenge for this venture. It is not ideal for mine site repurposing that the mining company has been required to subsidise the attraction on an ongoing basis. Operating the attraction is complex due to the range of stakeholders involved, health and safety regulation and insurance.

While the location has been raised as a limitation, Kalgoorlie-Boulder is a major city with existing tourism infrastructure such as transport, accommodation and other services. The case illustrates the importance of any post-mining tourism development being part of a wider tourism strategy.



Closure planning timeframe

4.5.2 Steps Towards Repurposing

Key enablers	Key hurdles
Strong community support and enthusiasm	Ongoing operational and maintenance funding
Financial support from KCGM	Obtaining affordable insurance
Identifying available and appropriate site for tourist mine	Health and safety regulation
Appointing education officer(s)	
Strong support from the city	

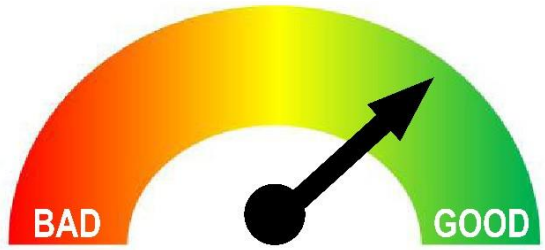
SWOT of the proposal/project

Strengths	Weaknesses	Opportunities	Threats
▪ City's strong history of gold mining ▪ Gold pour ▪ Gold panning ▪ Connection to city's gold mining heritage ▪ Visitor numbers increasing ▪ Venue for community events and education ▪ Resource to educate on mining history and attract a future workforce	▪ Lack of secure funding model for APMHF ▪ Artefacts on loan from WA Museum ▪ Expensive building to maintain ▪ No underground experience ▪ Location out of town ▪ City distant for tourism ▪ Limited accommodation options for tourism ▪ Site spread out and disjointed	▪ Location ▪ Create an underground experience ▪ Education ▪ Limited industrial tourism ▪ Limited experiences for children in KB ▪ Virtual reality underground experience ▪ Mogo or Sovereign Hill? ▪ A location for film and television productions	▪ Regulation ▪ Cost of relocation ▪ Tourism numbers to Kalgoorlie in decline ▪ COVID and continued travel restrictions ▪ Risk of volunteer-run organisation ▪ No ongoing source of funding and income limited

4.6 Newmont Boddington Gold Mine, Western Australia

Dashboard

Progress to date:



Prospects for success:

What is the vision?

Following the end of production at the Newmont Boddington Gold (NBG) the disturbed areas of land will be rehabilitated close to its pre-mining state – that being natural bushland. Some parts of the site will not be able to be rehabilitated to their pre-mining condition, in particular, the large pits created by the mining. It is planned that the large pits on site are to be converted into lakes, starting with Wandoo North, which is expected to spill into Wandoo South and eventually merge (Newmont 2012).

What has been achieved so far?

Future planning and preparatory actions have been embedded into the operations of the NBG mine, beginning before construction on site took place, and the operators project this planning will intensify as the closure of the mine draws closer (Newmont 2012; Newmont 2021b). The majority of operations occur in two large open pits, Wandoo North and Wandoo South. These pits are expected to continue to operate until 2036 and 2041 respectively, after which they will be rehabilitated.

With a view to the successful rehabilitation of the site, oxide, gravel and topsoil have been stockpiled to ensure adequate availability of materials critical to effective restoration. Guiding this work, an inventory has been created and calculations have been done to determine the soil profile of future areas of extraction.

Further informing the preparation for site rehabilitation, benchmarking trips were conducted at mines in the south west of Western Australia in 2012 to examine the post-mining land use planning and, for those that had closed, outcomes (De Sousa & Amoah 2012). Information from these sites was collected regarding 'landform design, rehabilitation techniques and expected performance, formation of pit lakes, outcomes of post closure activities and land use, stakeholder consultation and completion criteria' (De Sousa & Amoah 2012, p. 256).

Trials have been undertaken to identify the most effective closure covers for rehabilitation and to determine the effect of erosion on planned rehabilitated landforms (Newmont 2015).

The NBG site includes a number of shallow satellite open pits from which oxide was extracted between 1993 and 2001. Most of this area and the pits have been rehabilitated. The rehabilitation of this area included landscaping to replicate natural terrain, the application of topsoil, ripping and seeding as well as the planting of seedlings at the site. (Newmont 2012).

4.6.1 Background

Type of mine

The site now known as the Newmont Boddington Gold (NBG) mine was established after geochemical anomalies led to the discovery of significant gold mineralisation in 1980 (Newmont 2012). Since then, it has functioned intermittently, absorbing the neighbouring mine and adding copper extraction to its operations

(Newmont 2012). The NBG mine is an open pit mine, producing 703,000 attributable ounces of gold and 35,000 attributable ounces of copper in 2019 (Newmont 2021a; Newmont & Steward Redqueen 2020). In 2019, the mining lease area of the NBG mine covered 9,642 hectares of what is considered semi-arid land (Newmont 2019).

Location

The NBG mine is located in the Peel region of the south west of Western Australia on the Darling Plateau, 16 kilometres North West of the small town of Boddington and 120 kilometres from the State's capital city, Perth. The close proximity of the mine to the town of Boddington has led to the development of the town having a reliance on the mine for employment. Indeed, mining and associated operations accounts for 70% of local jobs (Peel Development Commission [PDC] 2020). Mining is also responsible for the vast majority of the LGA's gross revenue, linking into many aspects of life in the town (PDC 2020). NBG is not the only mine close to the town, with South32 Worsley Alumina extracting bauxite in the area (Boddington Community Resource Centre [CRC] 2021).

Leadership of repurposing

Newmont has formed a Closure and Reclamation Technical Team which is responsible for evaluating, coordinating and planning the risks, benefits and costs of post-mining land use (Newmont 2012; De Sousa & Amoah 2012). This team undertake regular consultation with discipline specific experts and representatives from the operational sectors at the site to ensure that their closure planning is following the best possible direction.

Each site has a dedicated senior staff member who focuses on closure planning and its relationship to the continuing operational activities.

Stakeholders

Newmont has been the sole owner of the mine since 2009. Newmont has highlighted the need for First Nations perspectives on the rehabilitation, with the traditional owners of the area and the South West Aboriginal Land and Sea Council (SWALSC) formally identified as stakeholders in the closure (Newmont 2012). In 2006, the Moorditj Booja Community Partnership Agreement was signed, acknowledging the

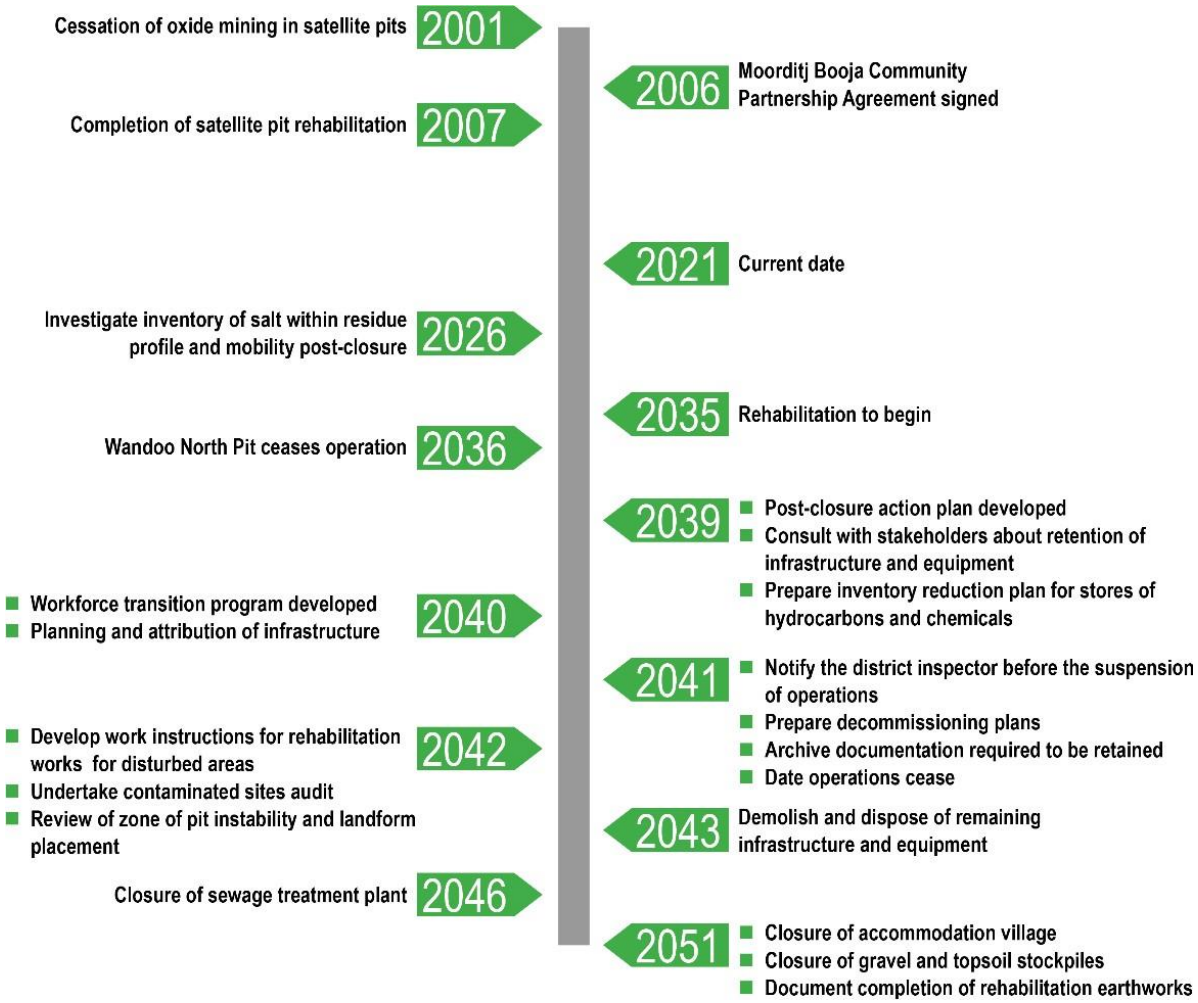
Gnaala Karla Booja people's traditional ownership of the land, with assurances of respect and cultural protection.

The area in and around the NBG mine is known for its ecological values, including being a destination for three species of threatened black cockatoos. Given these ecological values, other stakeholders include the Department of Biodiversity, Conservation and Attractions, the Department of Jobs, Tourism, Science and Innovation, the Department of Water and Environmental Regulation, the Department of Mines, Industry Regulation and Safety, and the Environmental Protection Authority.

As noted above, mining activity underpins the economic viability of the Boddington community, with NBG an important employer. In planning for the end of the mine, and the eventual site rehabilitation, NBG have identified as stakeholders, the 'Shire of Boddington, local landowners, Boddington and Dwellingup communities, local businesses, employees, service providers and regional organisations' (Newmont 2012 p 5-1, 5-2).

State of operations

The NBG mine is currently operating, but across its lifetime, it has experienced periods of being placed into care and maintenance due to factors such as ore exhaustion and low commodity prices. Since 2006, multiple expansions to the mine area have been undertaken, increasing the output and potential length of operation at the site. In 2019 the NBG mine directly employed approximately 1,200. The mine operations also supported a further approximate 5,300 jobs across the State (Newmont & Steward Redqueen 2020).



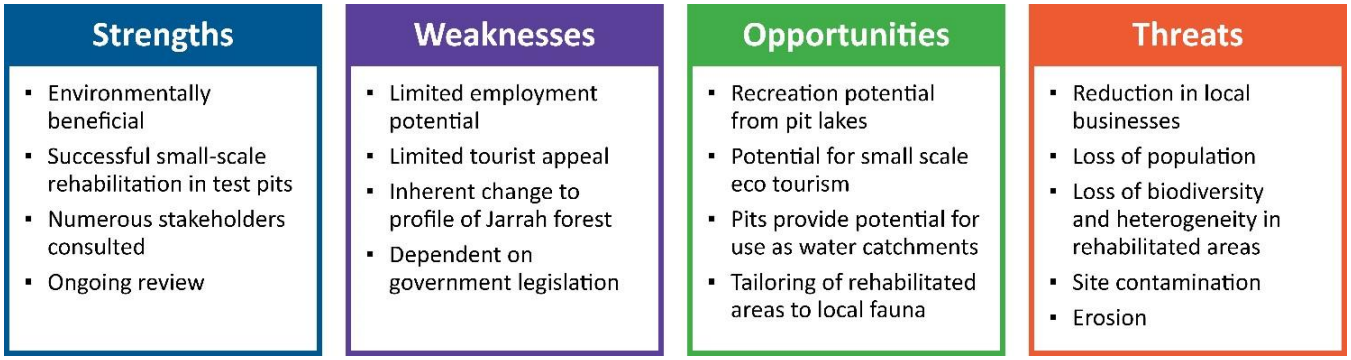
Closure planning timeframe

While closure planning has focused on ending operations at the site in 2041, provisions has been made for either an unplanned shutdown due to unforeseen circumstances, or the continued use of the site due to further expansion (Newmont 2012).

4.6.2 Steps Towards Repurposing

Key enablers	Key hurdles
Closure planning entrenched in organisational structures	Potential for the placement of NBG mine into care and maintenance due to unforeseen circumstances
Successful rehabilitation of previous satellite pits on site	Vulnerability of the area to fire due to dense vegetation, steep topography and access difficulties
Rehabilitation of sites by other mining organisations has been used to provide contextually relevant insight into practices that have been successfully applied in areas	Effects of climate change on replanted vegetation (rainfall reduction, increased evaporation and temperature)
Current high commodity prices allow for work towards post-mining land use to be implemented	Current lack of adequate back fill components
Established relationships with entities (such as the EPA and Murdoch University) that provide relevant information to support preparations for the rehabilitation of the site	Changing stakeholder priorities and changing government structures and priorities The projected size of the pits post-mining limits rehabilitation options Large projected quantity of waste rock on the site Large projected tailings storage facilities Risks caused by man-made landforms (pits, waste rock landforms) Costs of land rehabilitation Risks to water quality Potential spread of dieback (Phytophthora cinnamomic) from vehicle, person and resource movement

SWOT of the proposal/project

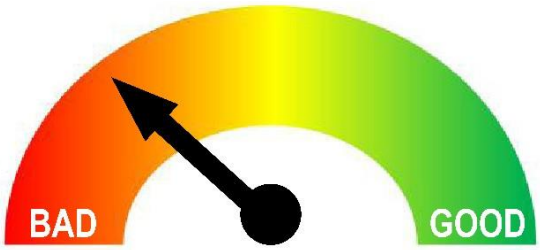


4.7 Hazelwood Lignite Mine, Latrobe Valley, Victoria

Dashboard

Progress to date:

Prospects for success:



What is the vision?

Under Victorian legislation, the mine operator is responsible for proposing plans for mine rehabilitation and future land use, which are then approved by the Victorian government. The vision detailed in the 'Hazelwood Concept Master Plan' (June 2019) is ambitious:

> *Through the reinvigoration of the historic economies that have made the Latrobe Valley what it is today, Hazelwood will catalyse a new era of energy, agricultural production, recreation and tourism for the Latrobe Valley.*

The Concept Plan envisages flooding the mine pit to create a large recreation lake and landscaping the surrounding areas, including the existing cooling pond and power station site. The Plan segments the site into areas for different land uses: active and passive recreation, a café, and an industrial precinct ('Productivity Hub') adjacent to the existing electricity switch yard, reserved for job-creating industrial activities.

What has been achieved so far?

The concept plan was released in June 2019, after community consultations, but it has not yet been approved by the Victorian Government. Nonetheless, the Hazelwood Power station building has been demolished. Work covering the batters (side walls) with soil for fire protection is ongoing, as is pumping of water to manage water pressure and stabilise the site.

4.7.1 Background

Type of mine

The Hazelwood mine is one of four open-cut lignite (brown coal) mines in the Latrobe Valley in Gippsland in Victoria. The mines have operated for almost a hundred years, resulting in deep and wide mine pits. The lignite in the Latrobe Valley is very close to the land surface, which means there is very little overburden and therefore not much material on site that could be reused to fill the pit voids.

Latrobe Valley lignite is low density material, with a density not dissimilar to the density of water. This creates serious issues for land stability, as discussed below. The density is about a quarter that of lignite mines in Germany and the United States, which limits the applicability of international best practice.

Location

The four mine sites in the Latrobe Valley are all located close to urban areas with established populations. Victorian government policies aiming to increase the population in these areas creates the imperative to improve local amenity and create more employment opportunities nearby. Urbanisation also means there are multiple active community groups with different interests in future land uses for the mine sites.

Importantly, the built environment increases the risks associated with the sites. First, there are problems with subsidence. The township of Morwell is slowly sinking into the Hazelwood pit – currently movement is only a few centimetres per year, but that rate would accelerate if current pumping of water to stabilise the pit was discontinued. In 2007, a diversion of the Morwell River – engineered to access coal for Hazelwood – failed, flooding the pit. Court cases allocating responsibility for this fiasco are still continuing. In 2011, the Princes Highway – which runs past the Hazelwood pit – started to crack and sink and had to be closed for months for repairs. The planned upgrading of the Highway to bypass the township of Traralgon cannot proceed until the stabilisation issues are resolved. In early 2021, the (diverted) Morwell River flooded the Yallourn Mine.

The Hazelwood Mine Fire in 2014 burned for 45 days, caused major health issues, and led to the partial evacuation of the adjacent township of Morwell. A subsequent enquiry found that the mine owners had not met fire safety requirements and that the Victorian government had not adequately policed compliance. A major inquiry followed, leading to the establishment of the MineLand Authority in 2020. The inquiry's recommendations have informed a review of mine regulation and rehabilitation standards, resulting in the Latrobe Valley Regional Rehabilitation Strategy (LVRRS).

Consideration of risks leads to the expert view that, to stabilise the surrounding land, there is no alternative but to flood all four mine pits. However, this raises issues about the impacts of pit flooding on local waterways and lakes, the evaporation effects on local climate, and the impacts on ground water (there is a theory that the filled voids will suck up the groundwater). These issues are important given Gippsland's agricultural economy.

Mine rehabilitation is contested locally and regionally. Different groups support different options. Community groups want rehabilitation to extend beyond the mines and power stations site – a scale issue – extending to cleaning up pollutants (particularly mercury) across the Valley. They want full Environmental Impact Assessments of the impacts of mine remediation proposals on Gippsland's waterways and the Gippsland Lakes.

Leadership of repurposing

In the Latrobe Valley, each mine is attached to and owned by a power station. Under Victorian legislation, the rehabilitation of the mine sites is the responsibility of the mine operator. The owner of the Hazelwood mine, the French transnational Engie is not interested in sponsoring repurposing activities beyond its

rehabilitation obligations. The Victorian government has de facto leadership through its attempts, over the last twenty years, to establish new industries in the Valley. These have consistently failed.

Repurposing is secondary to rehabilitation. The rehabilitation of the Hazelwood mine is a legal requirement. The cost of site rehabilitation was estimated in 2017 at $743 million, six times the amount anticipated in earlier closure planning, but the clean-up cost is increasing with the depth of understanding of the complexity of the task.

Each of the Valley's mines currently propose remediating the sites by flooding the pits to create lakes. This is a necessary stabilisation measure, and the resulting lakes might be made useful for various recreational purposes. However, it is unlikely that passive recreation would be a viable private sector initiative in an area with so much accessible public space and Crown land.

The concept plans for Hazelwood include land set aside for industrial uses, mainly around the existing electricity (switch yard) infrastructure. There is a plan to link the proposed second transmission connector from Tasmania into the Hazelwood yard. This is really continuing use of the existing infrastructure rather than repurposing.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
Mine operators	These are the power station owners, large energy firms	The costs of rehabilitation far exceed the funds held in bonds. Firms want a way to hand some rehabilitation costs back to government (e.g. the water to fill the pits). They are competing for access to water
Victorian Government MineLand	Has regulatory authority over the 'declared' mines	To find a way forward for the mine pits, defined as 'safe, stable, and sustainable' in the long term. A key consideration is avoiding management costs in perpetuity, which means full stabilisation in the short term. Wants to avoid a situation where the mine operators relinquish their bonds and walk away
Latrobe Water/Victorian Water	Regulates water use	Maximise the cost-efficient use of scarce water resources. This does not include flooding mines
Environment Victoria	Not-for-profit peak environmental organisation in Victoria	Wants a solution "the (Victorian) community is happy with". Sees itself as brokering a compromise
Community groups	There are a number of different groups, each with their own preferred repurposing option	For the community, the rehabilitation/repurposing has to be something they can live with. Rehabilitation is not only the mine site, it is also mining's effects in the Valley, especially environment impacts. The repurposing needs to create ongoing employment

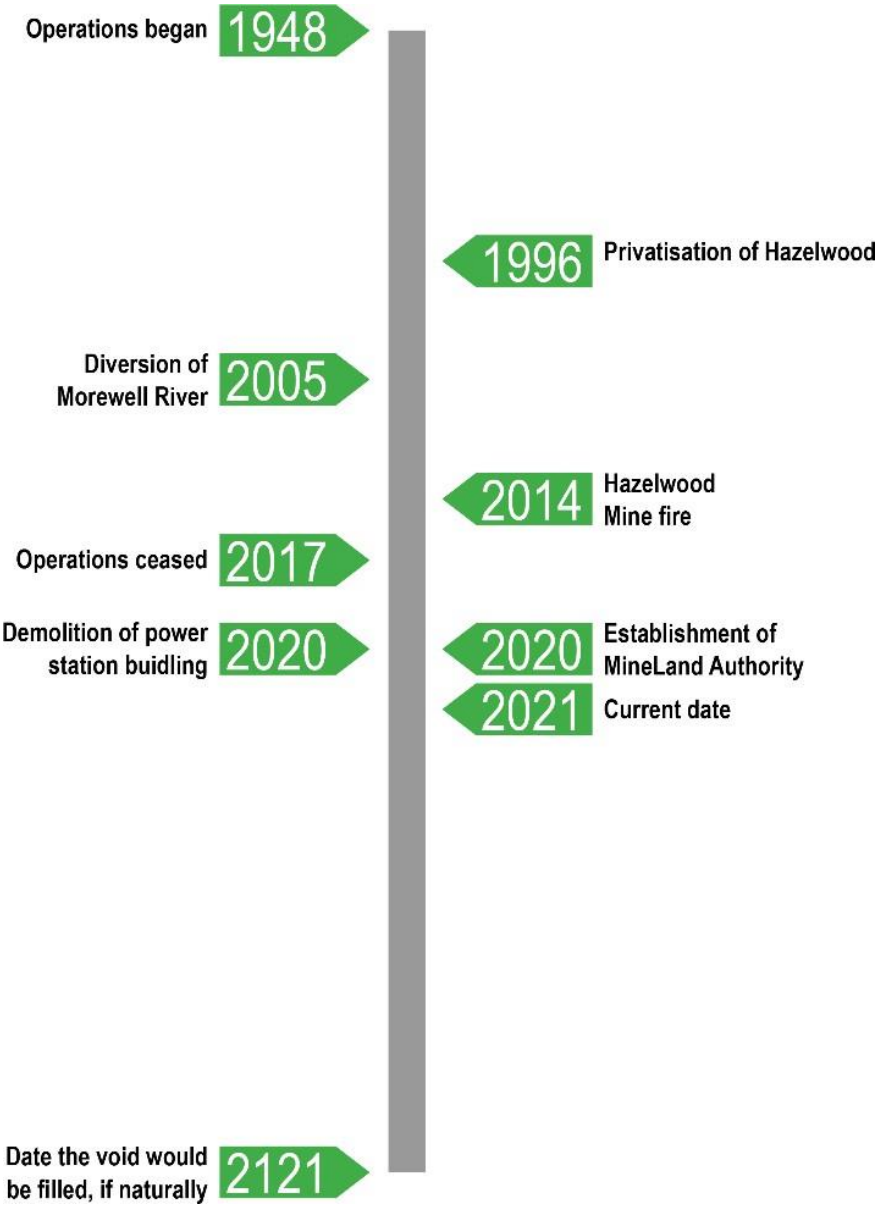
State of operations

The other issue is that the timing of the closures of the Latrobe Valley mines is a function of the national transition to renewable energy. This means the mines will close before their resource is exhausted. The rehabilitation and reuse of each mine individually is complicated by the need to take the other sites into account. This is an equity issue: the Loy Yang mine (operated by AGL) will be the last to close but if the other mines are flooded there will be no water left for it. This context requires coordinated planning for all four closures together, but the regulatory framework demands each operator propose their own individual plans.

The Victorian government has established a new authority – MineLand – to manage 'designated' mine sites; that is, sites with intractable challenges. Its remit is to ensure that rehabilitation plans for mines "set out milestones to achieve a landform that is safe, stable and sustainable, including measures to control identified risks" (DJPR, 2020). This includes removal of all mine infrastructure. Currently progress in the Latrobe Valley is being delayed by a Victorian government review of bond requirements.

This delay is giving MineLand time to 'educate' the community about the safety and stability issues. Meanwhile, there is continuing debate about what should be done and who should pay for it. The community is not yet convinced that flooding is the best option, so Engie's Hazelwood vision is by no means the accepted or inevitable path. The flooding option has hidden demerits: for example, in the Hazelwood case the highly toxic ash pit is half way down the pit, so it would be flooded with consequent contamination risks.

The principal stumbling block, apart from the social license issue, is identifying the source of the water that could be used to flood the mine. The Victorian government has determined that the flooding is not the best use of local potable water and that potable water from the nearby desalination plant is already committed to other purposes. The power stations' right to discounted water is currently linked to mining and power generation: once these activities cease, so does inexpensive access to river water. Currently the option being explored is piping recycled water from the sewage treatment plan in Melbourne, but this raises questions of cost and the suitability of that water.



Closure planning timeframe

4.7.2 Steps Towards Repurposing

Key enablers	Key hurdles
Hazelwood Fire Inquiry	The massive cost of land stabilisation, risks of further damage
Victorian government commitment to building up the Valley economy	Lack of available water for flooding
Victorian government establishment of MineLand to coordinate the response	Lack of overburden to push back into the void
Moving the problem forward slowly, in incremental shifts, to enable understanding to evolve	Lack of private industry interest in repurposing Lack of trust between government and community Environment risks beyond the mine site (Mercury, Gippsland Lakes) Competition between mine operators for best individual outcomes

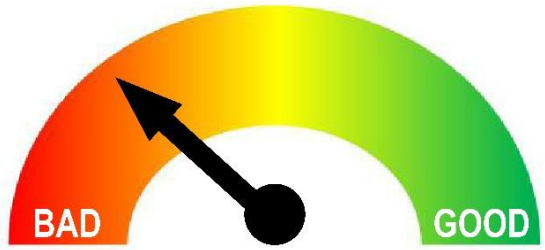
SWOT of the proposal/project

Strengths	Weaknesses	Opportunities	Threats
▪ Established infrastructure ▪ Commitment to economic development ▪ Established communication channels	▪ Costs of rehabilitation more than bonds ▪ History of disappointment ▪ Shifting regulatory goalposts ▪ Lack of trust between community and government and firms	▪ Will not emerge until rehabilitation issues are resolved	▪ Subsidence ▪ Fire ▪ Toxicity ▪ Discord

4.8 The Eden Eco-Tourism Redevelopment, Anglesea, Victoria

Dashboard

Progress to date:



Prospects for success:

What is the vision?

The vision is to redevelop the Alcoa Anglesea Power Station site and adjacent open cut coal mine site as an eco- tourism centre. The proposed development at Anglesea converts the mine void into a recreational lake surrounded by eco-tourism and hospitality venues on the perimeter. The actual components of the development are yet to be identified publicly and will depend on modelling of tourist demand and willingness to pay. The repurposing is planned in conjunction with Eden Project International, a firm established to encourage replication of the Eden Eco-Tourism and Biodiversity Park in Cornwall, UK. The Eden Project in Cornwall features greenhouse domes filled with exotic plants and promotes the sustainable use of plant resources. Climatic conditions and greater local familiarity with rainforest plants in Australia suggests that this proposal would need to develop its own locally appealing sustainability focus. The Alcoa mine rehabilitation plan had always envisaged filling the pit with water, so the Eden Project is building from that intention.

What has been achieved so far?

Alcoa's original plan for site rehabilitation – which was approved in 2011 before the Anglesea Power Station was closed - envisaged a pit lake surrounded by heathland. However, as a consequence of a legislative review following the Latrobe Valley's coal mine fire in 2014, the Victorian government tightened the regulatory framework and shifted to a more rigorous, risk-based model. The new framework requires firms to establish a set of rehabilitation and closure objectives, to specify criteria to be met prior to the firm exiting responsibility for the site, and to state the risks and strategies for their mitigation. The State government then assesses and approves these plans, guided by the Victorian government's core values which aim to create "safe, stable and sustainable" post-closure landforms.

In 2016 Alcoa circulated its five Guiding Principles for future land use at the site, which were developed after consultation with the community. These included 'to value and complement the natural environment', 'to recognise, celebrate and honour the site's cultural and heritage values' and 'to ensure consistency with the future and character of Anglesea'. A draft Mine Rehabilitation and Closure Plan was developed in 2017 and a Freehold Concept Master Plan circulated in 2018. In the meantime, and following stability concerns, Alcoa has conducted works to reduce the gradient of the mine walls (batters) and to make the mine safe from fire risks. The Plans for the site were the subject of further community consultations in 2019. These found considerable local support for the Eden proposal, with community concerns focusing on traffic management.

The Eden Project is supported vigorously by the parts of the state government concerned with tourism and regional development. Invest Victoria has responsibility for facilitating investment and clearing a path through regulatory and other barriers. Invest Victoria, which is focused on attracting foreign direct investment on projects of state significance, reports to the Minister for Economic Development and the Treasurer. Invest Victoria stepped in to assist the Eden Proposal, and started working actively with the proponents because of the project's potential to attract foreign direct investment. In the UK, the Eden

development was set up as a 'Special Purpose Vehicle' to attract investors, and its principal source of funding was the UK Lotteries fund. In Australia Eden is being marketed to investors and fund managers seeking environmentally sustainable investments. Invest Victoria facilitates that investment by identifying and addressing barriers to investment, such as those arising from regulatory approvals, planning approvals and water access. However, the proponent (Eden) remains responsible for the Prospectus and the engagement of investors. It has conducted a (confidential) cost-benefit analysis, which affirmed the project's potential economic benefit to Victoria through building local employment and increasing the tourist spend on Ocean Road.

Nonetheless, approval of Alcoa's final plan has been delayed by a Victorian Government review of mining rehabilitation bonds, possible changes to regulation following an Audit-General's review of mine rehabilitation in 2019, and concerns about establishing a precedent that could affect Latrobe Valley mine flooding plans. The Auditor-General's August 2020 Inquiry in Mine Rehabilitation in Victoria uncovered systemic regulatory failures in mine rehabilitation that produce unacceptable ongoing contingent liabilities for the Victorian government.

The deficiencies in governance including inadequate rehabilitation bonds, inadequate specification of rehabilitation plans, inadequate monitoring of rehabilitation efforts, and lack of enforcement of rehabilitation requirements. The review has prompted policy revisions in relevant government departments, resulting in some uncertainty for the Eden proposal.

4.8.1 Background

Type of mine

The Anglesea open cut mine supplied brown coal (lignite) to the adjacent Anglesea power station. It was established in the 1960s as a dedicated energy source for the Alcoa Point Henry smelter in Geelong. The power station and mine were closed in 2015.

Location

This mine is located just north of the coastal township of Anglesea, sited on the Anglesea River. Anglesea is a tourist and retirement town situated on Victoria's surf coast about 20 minutes west of the booming city of Geelong. The site abuts State forest on the edge of the Otway Ranges to the north. The area's economy is already based on tourism, so the proposed Eden development in keeping with the economic profile and is well positioned to attract day-trippers from Geelong and Melbourne. The power station was always incongruous to this location.

Leadership of repurposing

Alcoa is the firm responsible for the rehabilitation of the site. The repurposing proposal has been developed in conjunction with Eden Project International, a firm established to encourage the replication of the UK's Eden Eco-Tourism and Biodiversity Park in Cornwall. The selection of the Anglesea site reflects Eden's partnership with Alcoa rather than the qualities of the site. Currently Invest Victoria is leading the coordination of re-development.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
Alcoa	Operator of the mine (private sector)	Orderly exit from the site
Eden International	Proponent of Site Repurposing (not for profit)	Develop site for commercial tourism
Department of Environment, Land, Water and Planning (DELWP)	Victorian Land and Water Policy (government agency)	Secure the site in perpetuity
Environment Protection Authority (EPA)	Manages environment risks (government agency)	Ensure rehabilitation is safe and sustainable
Invest Victoria	Victorian Government investment facilitator (government agency)	Facilitate investment at the site
Southern Rural Water	Ground water licence issuer (statutory authority)	Ensure optimal water allocation
Catchment Management	Manages surface water (statutory authority)	Ensure environmental flows
Barwon Water	Water issues (statutory authority)	Ensure optimal water allocation

State of operations

The Anglesea power station and mine operated under purpose-specific legislation, the Aluminium Agreement Act, put in place in the mid-1960s. That Agreement has some location specific aspects with regard to land use but relied on reference to regulations in the then Mineral Resources Sustainable Development Act (MRSDA). The land occupied by the power station is not part of the mining lease. Part of the mining lease is on Crown land.

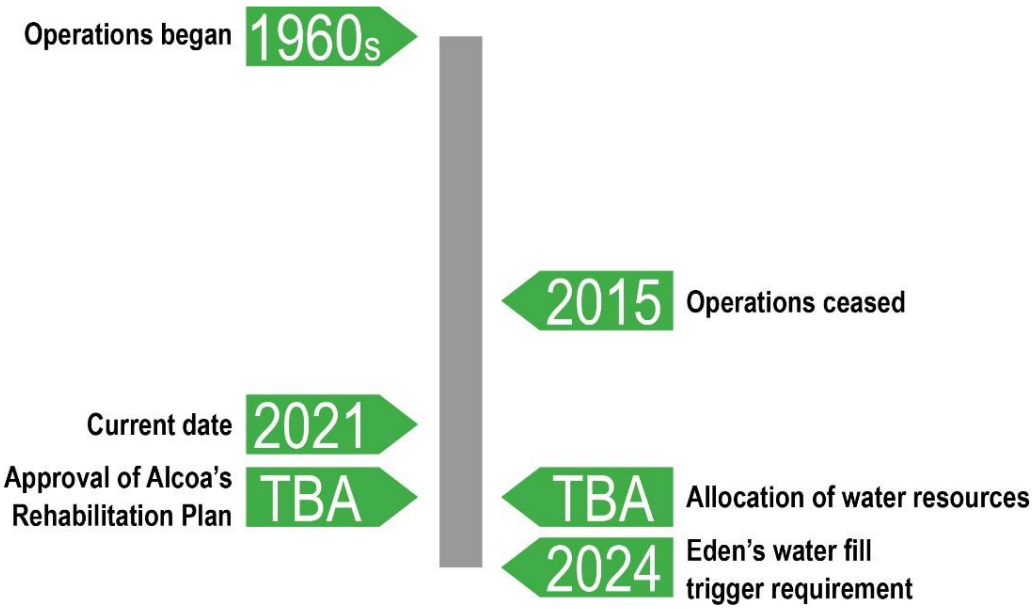
There is an existing EPA license covering the management of the power station, an on-site asbestos landfill, and deposits of fly ash from the power station.

Water availability is a fundamental question for both the original planned rehabilitation and proposed repurposing in the Eden Project for the Anglesea pit. Filling the pit void requires a significant amount of water. The pit would fill naturally over time, via rainfall run-off, so the water issue is being framed as slow-fill versus rapid-fill options. Rapid fill is needed to facilitate Eden's entry into the project, and Eden has suggested the trigger be a 50% fill by 2024. The options to achieve this include pumping groundwater, diverting river water, piping wastewater from the Werribee treatment plant, and commissioning second desalination plant. Alcoa is currently examining the feasibility of pumping ground water – that is, testing whether the aquifer below the (geological) Eastern View Formation would be a suitable source of water for the pit lake. When the power station was operating, the Alcoa power station drew water from this source, but its license to use the water was tied to the power station's operation.

The Eden repurposing proposal is stalled by water availability issues. Resolving the water issue is hampered by gaps in knowledge and understanding about the interaction of different water sources, by a complex regulatory context in which each water source has a different responsible regulatory agency, and by concerns about setting precedents that could reshape options in the Latrobe Valley (which is also in Victoria). The Victorian Department of Environment, Land, Water and Planning (DELWP), which regulates the use of the water, has raised questions about the availability of water to fill the void and about whether filling the void is the optimal use of scarce water. DELWP is also keen to ensure that the revegetation elements of the rehabilitation are consistent with the surrounding National Park since much of site's land will revert to Crown Land after Alcoa's relinquishment. This objective might contradict Eden's ambitions. The EPA is involved because it is responsible for monitoring compliance with existing licenses on the site and for assessing potential environmental harms created by a pit lake.

Another unresolved question concerns the fly ash from the power station, currently stored at the eastern end of the pit. Currently the void flooding plan would completely submerge the ash, with potential implication for water quality in the lake. Fly ash is relatively benign but has elevated metals, including Boron. The problem is that the water in the Anglesea River is naturally quite acidic (PH 5), and it is not known how fly ash might react with acid water. The EPA is investigating this aspect, including its effect on water in the pit and the likelihood of leakage into the groundwater. There is an adjacent asbestos landfill which is maintained to EPA requirements and is not expected to impact water resources. However, even if a pit lake is approved, acidity issues make it 'highly unlikely' that it would be suitable for any form of active recreation.

How quickly Alcoa can meet its rehabilitation obligations and exit the site depends on Victorian Government approval of their submitted Final Plan, and the criteria contained therein. After that, it is unclear what ongoing responsibilities would fall to the Eden Project, another issue that would need to be resolved before it proceeds. The site will revert to Crown Land eventually, so the Victorian government carries default responsibility.



Closure planning timeframe

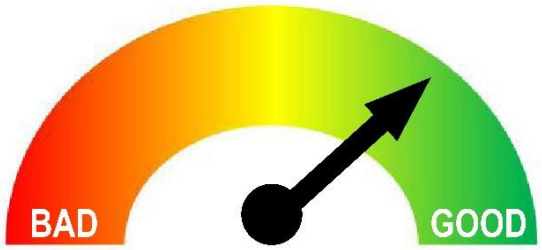
4.8.2 Steps Towards Repurposing

Key enablers	Key hurdles
Alcoa's commitment	Water availability
Eden's interest	Environmental effects
Invest Victoria's interest	Weak cost-benefit case
Community Support	Dearth of investors

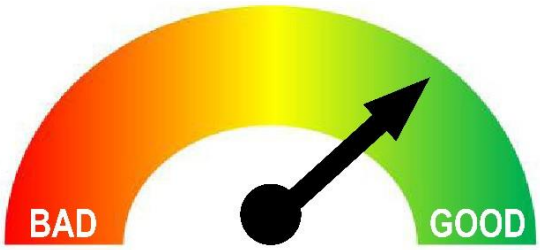
4.9 Stawell Underground Physics Laboratory (SUPL), Stawell, Victoria

Dashboard

Progress to date:



Prospects for success:



What is the vision?

In 2013, due to rising costs associated with deep gold reserves, the Stawell Goldmine (SGM), communicated through regular meetings with the community, particularly the local government authority, the Shire of Northern Grampians, warning that transition to closure was potentially imminent. The community was keen to seek alternative uses for the mine that would maintain local employment and support the local community.

Simultaneously, physicists were seeking a southern hemisphere location for a deep cavern in a rock-protected location to conduct experiments for the potential detection of dark matter, the mysterious substance thought to make up to 80% of matter in the universe.

The Stawell Underground Physics Laboratory (SUPL) was subsequently proposed, located one kilometre below ground in what was, until 2012, a deep volcanic basalt gold mine cavern. The depth, equivalent to a shield of three km of water, is important for blocking the earth's surface radioactive cosmic waves which are unable to infiltrate the abandoned mining tunnels, maximising the effectiveness of the very sensitive detectors and sensors for exploring the theorised existence of dark matter (Slezak, 2014).

The laboratory will occupy a bespoke cavity created by excavating two interconnected caverns. When completed in 2022, it will be approximately 30 metres long, 12 metres high and 10 metres wide excavated into the rock from an existing part of the mine, with enough room for experimental laboratories, physical plant and other support facilities, loading bays and lay down areas (Urquijo, 2016). Sophisticated air purification systems will be integrated into the already installed ventilation infrastructure, left over from mining operations. Another significant advantage of this mine site is access to the cavern by ramp rather than a vertical shaft, enabling power and equipment to be driven into the construction and operation site, offering economical access solutions. Power and fibre-optic facilities are also already in place from the previous mining operations.

According to SUPL foundation physicist, Professor Elisabetta Barberio, the confirmation of the existence of dark matter is a global challenge, which if solved, would be worthy of Nobel prize nomination (Duffy & Barberio, 2015).

What has been achieved so far?

In July 2019, a memorandum of understanding between Stawell Gold Mines Pty Ltd, the Northern Grampians Shire Council and the University of Melbourne was signed to build and operate the laboratory with funding from the Australian Commonwealth and Victorian state governments. In 2019 the Australian Research Council awarded $35m for the development of a Centre of Excellence for Dark Matter Particle Physics. Funds and resources were also secured from the Gran Sasso Laboratory (Laboratori Nazionali del Gran Sasso (LNGS) based north east of Rome (Italy), the largest underground physics laboratory in the world. The SUPL facility at Stawell is due to commence operation in early 2022.

Location

The SGM on Big Hill is located on the edge of the Stawell township, 240 km west of Melbourne. Stawell is a small town of 6,000 people, best known in the 21st century for farming and the annual footrace, the Stawell Gift, held each Easter. Goldmining has been a feature of the local economy, intermittently since the 1860s. The mine was closed in the 1920s and re-opened in the 1980s.

The site consists of 100 ha crown land and 420 ha freehold land. It is well serviced with:

- Natural Gas
- Electricity (22kW)
- Fibre Optical infrastructure
- Sewerage
- Potable and raw water infrastructure
- Water dams (total capacity 652 ML)
- Close access to Western Highway.

4.9.1 Background

Type of mine

The SGM is a gold mine. At its peak in 2011 the SGM was the largest employer in the Stawell area and contributed over $58.3 million to the local community in wages, purchased goods and services per year (Northern Grampians Shire Council, 2014). The mining industry within Northern Grampians Shire, as a sector, represented 19.1% of Gross Regional Product, the mine directly employing 400 people with many other local businesses supporting the industry. Consequently, the community and businesses benefitted indirectly from the mine's success.

By 2012, the gold reserves were increasingly at depth, requiring considerable capital and technological infrastructure. Discussions regarding the impact of potential closure continued. By 2014, SGM the workforce had reduced to 145 and modelling estimated the impact of the SGM job losses at a direct decrease in the

Shire's output of $410m. Further impacts were estimated at $42m in decreased demand for immediate goods and services and $30m in reduced consumption (Northern Grampians Shire Council, 2014).

The mine site was eventually put into care and maintenance in 2016, although production re-commenced a year later under new ownership when the price of gold made production viable. The mine owners were nonetheless still open to potential repurposing initiatives, most particularly the SUPL, in the deeper, exhausted mine areas (McKenzie, 2014) and committed to provide resources to assist the establishment of SUPL.

Leadership of repurposing

In 2013 the Northern Grampians Shire convened a Project Control Group comprised of a range of representatives from the community, local government, state government agencies, business operators and the mining industry, including SGM, to consider potential transformation and repurposing initiatives for the SGM assets. Nothing was ruled out in the early discussions.

The key assessment parameters were:

- economic feasibility of the plan;
- deliver employment and economic outcomes;
- align to regional development policies;
- add value to, or build local and regional economic strengths and capacity;
- leverage investment partnerships; and
- community net benefit.

Coincidently, scientists were seeking a suitable southern hemisphere location for sophisticated physics experiments to complement work being undertaken by Laboratori Nazionali del Gran Sasso to identify the existence of dark matter. When the negotiations between all levels of government and the scientists commenced in 2014, 60 international scientists arrived in Stawell to inspect the proposed site of the southern hemisphere's first underground physics laboratory, ascertaining how well the proposed laboratory was shielded from unwanted background radiation and evaluating the supporting site infrastructure. Indirectly, the visitors boosted local tourist businesses and confidence of the Stawell community in the project.

The Stawell Gold Mine was identified as a probable location for this laboratory with some unique advantages over other sites in the world, such as:

- geographic suitability;
- geopolitical stability;
- easy access for the scientific community;
- willing local partners; and,
- investment ready site with suitable support infrastructure and services.

The SGM played an integral role. The company committed to excavating the necessary underground cavern, and while the mine continues to operate, provide ventilation, electrical and fibre-optic infrastructure and maintain vehicular access and water management. While the mine continues to operate, SUPL staff are trained in mine safety protocols. Co-locating with SUPL has required considerable efforts by SGM staff to renegotiate the mine license and regulatory frameworks for operation. However, the company's commitment to the SUPL initiative was also to that of the community of Stawell. The company's workforce is 100% residential; their families are often deeply connected to the town and the community. Accommodating

SUPL was viewed as part of the SGM's corporate social responsibility. However, SGM has made it clear that it will support SUPL while the goldmine is operational but that after closure SUPL must be self-sustaining. Consequently, working closely with the Northern Grampians Shire and the community was a priority.

The Shire chief executive officer, the mayor and council advocated for SUPL at the local, Commonwealth and Victorian state government levels. They also used the SUPL initiative to drive education aspirations for local high school students, highlighting potential future employment opportunities for those interested in science, technology, engineering and mathematics (STEM). This had a marked impact with approximately 30% increase in local student uptake in STEM subjects, further consolidating local commitment to the SUPL initiative.

The Gran Sasso facility attracts thousands of students and visitors each year and it is hoped that SUPL will also offer new opportunities for tours and an expanded visitors centre for the town. The Stawell facility, once operational, will attract physicists, visiting scientists, research students and potentially, scientific tourists from around the world for extended periods, offering local businesses the opportunity to showcase Stawell, local tourism and food products in an aesthetically attractive location in regional Victoria. The town already caters to a regular influx of tourists associated with the annual Stawell Gift and SUPL provides the opportunity to extend visitations and make more permanent investment in tourism offerings which will benefit Stawell residents. The Northern Grampians Shire is hopeful that specialist manufacturing and technical support businesses will also be attracted to Stawell to supply SUPL, as has occurred in Gran Sasso. Small businesses in the regional area of Gran Sasso pivoted to support the facility, with one transitioning from a small family business to a multinational company making specific inert components for the laboratory.

Dark matter is not the only research opportunity envisaged for SUPL. Other researchers are keen to investigate the effect of low radiation conditions on cancer cells, particularly cervical and breast cancers. Meteorite experts are also eager to use the facilities to link with space-based detectors, such as the Alpha Magnetic Spectrometer on the International Space Station for experiments previously only undertaken in northern hemisphere skies.

In Stawell, it is expected that SUPL and its spin-offs will generate 80 new jobs and an estimated $18m annual boost to the local economy through the attraction of new business opportunities to the town (Northern Grampians Shire Council 2014). This will be a significant boost for the town, which was significantly impacted by the contraction of the mining sector over the last two decades (McKenzie, 2014), and other depopulation trends symptomatic of rural communities.

This case study highlights opportunistic collaboration between unlikely partners. It will re-pivot the local economy and businesses to support a high value knowledge industry, taking advantage of redundant physical assets of a gold mine. Construction of the bespoke laboratory requires on-site preparation of special building materials for the walls, stored away from other mine materials to prevent radiation and other contamination that could interfere with future experiments in the laboratory.

State of operations

The SGM continues to operate with no current closure date.

4.9.2 Steps Towards Repurposing

Key enablers	Key hurdles
Geographic and geological suitability	Changing compliance and regulatory frameworks
A company with strong commitment to the local community	Operating a highly technical physics laboratory alongside an operating mine
Strong financial support from State and Commonwealth government	

A committed, well informed local government authority

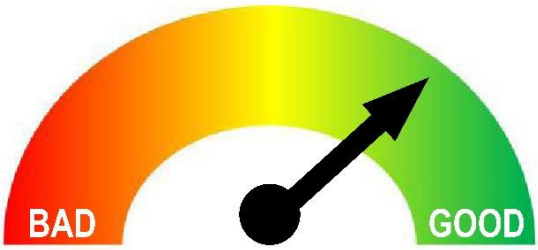
SWOT of the proposal/project

Strengths	Weaknesses	Opportunities	Threats
▪ Geographic suitability ▪ Geopolitical stability ▪ Easy access for the scientific community ▪ Willing local partners ▪ Willingness by company to collaborate, co-operate and support SUPL ▪ Investment ready site with suitable support infrastructure and services	▪ The SUPL will have a reduced workforce/ visitors ▪ Decreased interest in dark matters ▪ Co-location of a scientific facility alongside an operating mine site	▪ Direct and indirect employment ▪ Support business development ▪ Education and training ▪ Local industry diversification ▪ New, high end scientific businesses	▪ Long-term sustainability without company support ▪ Company commitment ▪ Failure of the physics experiments

4.10 Gove Bauxite Mine, East Arnhem Land, Northern Territory

Dashboard

Progress to date:



Prospects for success:

There has been strong progress to date and the prospects for a viable community are positive – different stakeholders have different expectations so this will vary between neutral and very good, depending on these expectations. It is important to note, however, that the planning has focused on the ongoing viability of the community/township rather than the reuse of the mine site.

What is the vision?

Rio Tinto own and operate the Gove Bauxite Mine near Nhulunbuy in Northern Territory (NT). The mine will close in 2030. Following the closure of the Aluminium Refinery at Gove in 2013, Rio Tinto has worked with various stakeholders towards planning a viable and sustainable future for Nhulunbuy and local communities, which meets the needs of Traditional Owners and other stakeholders. For Rio Tinto, the vision is for a mine closure with the gentlest possible exit from the region. Nhulunbuy is a company town, owned and managed by Rio Tinto and the community needs to transition to an alternative economic base. It has emerged as an important regional hub and administrative centre for government services.

The Traditional Owners' vision of post-Gove Nhulunbuy is for a shared Aboriginal and Balanga town, with an economic base that is more sustainable and sensitive to the land in the longer term. The work towards achieving this vision is overseen by the Gove Futures Reference Group, established by the NT Government and incorporating a range of community stakeholders.

The NT Government seeks a post-mining future for Nhulunbuy that does not require significant ongoing subsidy. There needs to be a sufficient population to sustain ongoing services provision. Nhulunbuy was built as a mining town and it is anticipated that it will contract after the mine closes but will continue to be a major services centre for the wider East Arnhem Land region though serving a reduced population. Tourism has been proposed as a key industry for Gove in the future. NT Tourism has funded a Tourism Development Officer at Development East Arnhem Land Limited (DEAL) and Nhulunbuy Corporation, which has delegated authority from Rio Tinto to manage the town, has opened a Visitor Information Centre and the internationally recognised and celebrated Yirrkala Art Centre attracts many from outside the region. Local infrastructure is a challenge for tourism development, even at a limited scale. Access to the region is by an unsealed road and there are issues with the reliability of the air service. There has been interest from smaller cruise ships (80-120 passengers) to visit. A land tenure agreement needs to be completed with the Traditional Owners to enable access to the shoreline. Any tourist to the region needs a permit and DEAL are working with Traditional Owners to improve education and knowledge about the application process.

The general perspective from different stakeholders towards the future of Nhulunbuy is positive and there is a shared high level vision for a sustainable future for the community.

What has been achieved so far?

The catalyst for the current repurposing plan was the closure of Rio Tinto's Aluminium Refinery in 2013, which highlighted the challenges for Nhulunbuy and the local community in East Arnhem Land. The closure

of the refinery had an impact economically and socially as 1,400 people were made redundant within a community of approximately 4,000. To date, work led by the NT Government has focused around engaging stakeholders and reaching agreements about post-closure land and asset ownership. A Gove Futures Reference Group (GFRG) has been established to bring the relevant stakeholders together.

Two key decisions underpin the process of transitioning the town to a viable post-mining future. These is an agreement between Rio Tinto and the Traditional Owners, signed in 2009, which sets out the legal process for a disposal of assets and gives the Traditional Owners first refusal on any assets. The second was a change to the Land Rights Act to allow Traditional Owners to make decisions over land in escrow. The Northern Land Council has agreed to that change. The land on which the mine and town are situated is Aboriginal land and will revert to the Traditional Owners following the mine's closure. This legal change will facilitate bringing new non- Aboriginal people into the town to establish new businesses after the mine's closure.

GFRG has enabled the Traditional Owners to set out the kind of community they wish to see post-mining. GFRG has six work streams: central services, economic transition, Government, Community Services, town governance, and land tenure. GFRG's first stage of work was to work with the Traditional Owners to set out what kind of post-mining community they want for Gove. This led to an additional work stream: Yolngu and Balanga (non-Yolngu) working together.

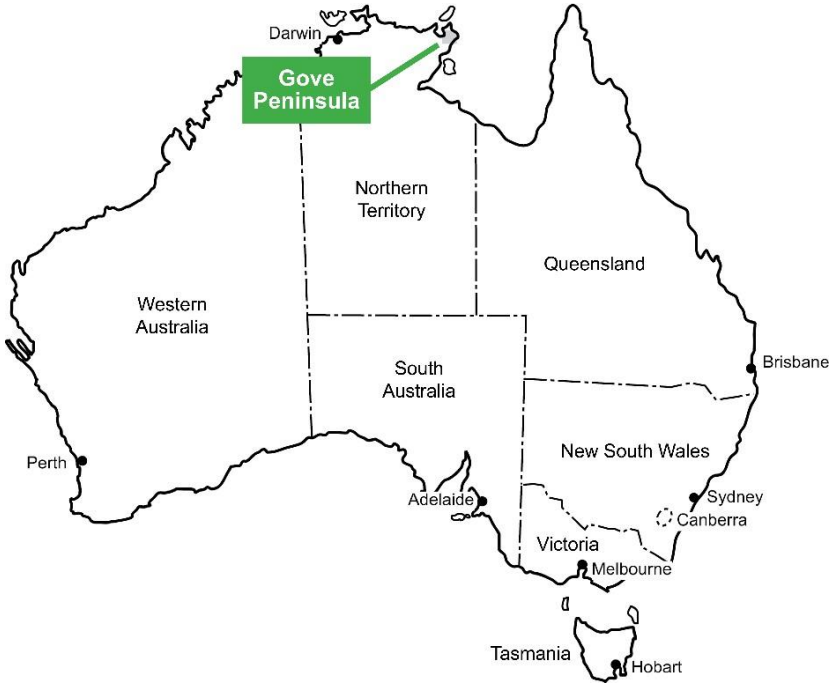
4.10.1 Background

Type of mine

Gove is a bauxite mine. The mine infrastructure includes a deep water dock, airport and the townsite of Nhulunbuy, which is currently owned and managed by Rio Tinto. Nhulunbuy is described as a small functional country town.

Location

The mine at Gove is located in remote East Arnhem Land. In addition to the airport and a dock, land access is via one unsealed 700 km road. The location is both an opportunity and a constraint for future post-mining economic diversification. Travel and freight to Nhulunbuy is expensive and any kind of building or development is also costly.



Leadership of repurposing

The closure of Rio Tinto's aluminium refinery in 2013 was the catalyst for the current level of progress towards a post-mining plan for Gove and Nhulunbuy. The planning process has been led since 2015 by the NT Government. Initial work involved engaging internal stakeholders and agencies within the NT Government. The next phase involved engaging with Rio Tinto, followed by the Northern Land Council and the Traditional Owners. This has created a strong governance framework for post-closure planning, which is overseen by the GFRG, established in 2019. GFRG involves all the aforementioned stakeholders, pursuing various work streams related to different aspects of the mine closure, such as housing in Nhulunbuy.

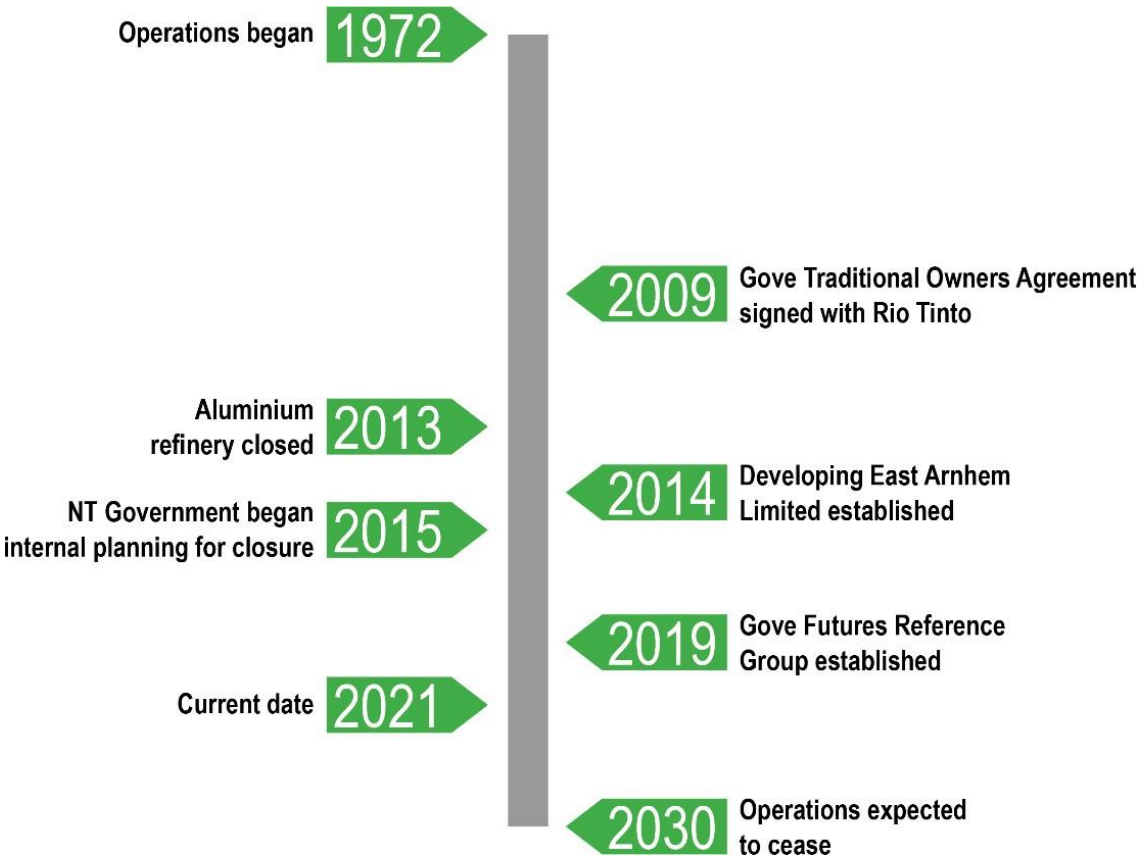
Development in the area has been supported by DEAL, which is an independent not for profit company established with seed funding from the NT Government and Rio Tinto in 2014, following the closure of the aluminium refinery. DEAL's role is to attract and support new businesses in the area. Northern Territory Tourism has funded a Tourism Development Officer to create a 10 year Destination Management Plan for the area.

Stakeholder	Brief description of stakeholder	Stakeholders' interests
Rio Tinto	Mine owner and operator	Mining, mine closure and gentle exit from region
Gove Peninsula Futures Reference Group (GFRG)	A group of stakeholders including Rio Tinto, the two TO corporations, Northern Land Council, Australian Government and NT Government planning the economic social transition of the Gove Peninsula	Oversight of a viable transition for the local community
Developing East Arnhem (DEAL)	An independent not-for-profit company with the mission to drive economic development in East Arnhem	Economic diversification for the region
Northern Territory Government	State Government	Oversee mine closure Plan economic future post-mining to reduce reliance on government subsidies
Commonwealth Government	Federal Government	Oversight of Aboriginal land
Northern Land Council	Independent statutory authority of the Commonwealth with responsibility for assisting Aboriginal peoples in the Top End of the NT to acquire and manage their traditional lands and seas	Support for Traditional Owners and ensure land rights
Gumatj Corporation	Traditional Owner	A sustainable and culturally appropriate future for the Gumatj people
Rirratjingu Corporation	Traditional Owner	A sustainable and culturally appropriate future for the Rirratjingu people
Local community in Nhulunbuy	Local community	A viable economic and social future for the town

State of operations

Gove aluminium refinery is being dismantled. This work has increased Rio Tinto's workforce in the region and the town of Nhulunbuy is currently at capacity. Rio Tinto began releasing housing assets in 2020 and this will continue to be staged. There are limited opportunities for new people or businesses to move into the town unless there is a significant investment in housing. Rio Tinto may open up housing if they move more of their workforce to FIFO, but this will only be if there is an operational need.

Even after Rio Tinto exit Gove, there will continue to be bauxite mining as the Gumatj Corporation own and operate a smaller mine. Potential future industries for the Gove Peninsula are forestry, land management, fisheries, cattle export, tourism, space and defence as well as services such as education, health, aged care and infrastructure construction and maintenance. There will be short-term employment rehabilitating the mine site and the mine will leave a number of assets such as the deep water dock with fuel storage tanks, a wharf and warehouses. The area also has natural assets such as wind and sun, which lend themselves to renewable energy generation and enclosed grids for green manufacturing. Gove is also close to major shipping lanes and Asia.



Closure planning timeframe

4.10.2 Steps Towards Repurposing

Key enablers	Key hurdles
Agreement between Rio Tinto and TOs	Lack of housing
Long term planning instigated by NT Government	Land tenure
DEAL Gove Futures Reference Group and Rights Act Amendment Funding of Tourism Development Officer	Remoteness and limited access

SWOT of the proposal/project

Strengths	Weaknesses	Opportunities	Threats
▪ Shared high level vision ▪ Long term planning ▪ GRFG ▪ DEAL ▪ Nhulunbuy VIC ▪ Existing mine assets ▪ A strong traditional Aboriginal culture	▪ Different time frames ▪ Lack of housing ▪ Regulation ▪ Remote location ▪ Access ▪ Small town ▪ No pre-mining history ▪ Cost of doing business ▪ Reliance on subsidies	▪ Mining infrastructure ▪ Location ▪ Rich local culture ▪ New industries: tourism, forestry, space base ▪ Yolngu and Balanga collaboration	▪ Unrealistic expectations ▪ Resourcing of key stakeholders ▪ Stakeholder agendas ▪ Lack of transparency ▪ Key staff turnover ▪ Relationships break down ▪ Reduction in population ▪ Loss of mining royalties ▪ Reduction in median income for Nhulunbuy

4.11 Indigenous Interests Directory Pilot

What Is The Vision?

Indigenous communities should be key stakeholders in decisions about extractives-led development. Engagement is essential for those groups who hold rights and interests in land which may be impacted by corporate or government decision making.

This pilot study aims to elevate Indigenous interests in mine closure and repurposing planning by providing a transferable framework to establish a comprehensive directory of Indigenous interests. The directory provides a pathway for mining companies, individually or collectively, to constructively engage with identified Indigenous interests (existing business, corporations etc), and consequently to enable long-term and equitable engagement with Indigenous peoples in these regions. It is also expected that the pilot study will provide a greater understanding of the complexity of the Indigenous cultural, economic and institutional landscape, and the range of groups and organisations with interests in long-term land use planning.

This pilot study also performs a secondary purpose in the context of CRC TiME. The framework can provide a basis for engagement with relevant Indigenous interests and groups, either in the Moranbah region or applied elsewhere, to ensure that opportunities for connection and relationship building are systematically recognised and pursued in partnership[2].

Why Is This Important?

While stakeholder mapping is familiar to community relations practitioners, it is rarely undertaken at this level of detail for Indigenous interests, or with regard to long-term land use planning including mine closure and repurposing. A directory of interests provides one of the steps toward collaboratively building a shared vision of post mine options and potentially encourage consideration of repurposing projects that are co-developed with Indigenous groups, as opposed to top-down or driven externally.

4.11.1 Pilot

The framework described below was piloted for the Moranbah Region in Queensland to elaborate and refine categories and test its potential. The Moranbah region, within the Bowen Basin in Queensland, is increasingly focused on planning for the closure of multiple mines and investigating options for its future. Individual mines in the region are also completing their first Progressive Rehabilitation and Closure Plans under the new Queensland Government's Mineral and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act).

While we are not presenting the completed Moranbah Region Directory here for the sake of brevity, we were able to gather a large amount of information is based on internet-based research. For example, we identified local native title and cultural heritage claim groups, local organisations, businesses and planning processes with an interest in the region. In reality, this information would need to be supplemented by engagement with these organisations and on-the-ground in the region's communities to fill gaps and verify information. This framework does not extend to identifying the qualitative aspects of the landscape of Indigenous interests (e.g., the capacity of organisations and individuals, cultural connections to specific places, group and individual aspirations, values, and relationships). The application of this tool to establish an

[2] The conception of an Indigenous interests directory also included a regional baseline of the Indigenous population profile and a broader, and more engaged process, rather than this desktop-only pilot, as per the CRC TiME Ideation "Indigenous regional baselines and mining transitions: Engaging at the interface" by Dr Sarah Holcombe from the Centre for Social Responsibility in Mining. In the early stages of this pilot, discussions were held between Keenan and Holcombe.

engagement process would require relationship and trust building with participants, and a commitment to ensuring that the perspectives of Indigenous participants influence decision-making.

Framework

This directory was designed to provide a framework for researching and organising the range of Indigenous interests in a region, with particular attention to Indigenous rights, long-term planning, and development support initiatives.

The main categories cover:

- Indigenous representation and governance: legal, social and community based organisations
- Indigenous-industry interface: instruments connecting Indigenous groups and industry, including Indigenous businesses:
- Multistakeholder/mainstream governance and interest groups: planning and governance groups which include Indigenous peoples as key stakeholders

Within each of these categories, the framework identifies sub-categories for further research and engagement. Together these build a picture of the institutional landscape from which an understanding of the various priorities, values and aspirations of Indigenous people can be engaged.

Figure 3 shows the directory framework. Categories and sub-categories may be added as needed.

Figure 3: Indigenous interests directory framework

Gaps

One of the significant gaps in this directory is information about existing relationships with mining operations, aside from registered agreements. While agreements are an important instrument governing aspects of Indigenous-industry relationships, engagement with Traditional Owners and other local Indigenous groups often occurs outside agreement provisions. For example: community consultative committees (as different to agreement governance committees), general Indigenous employment, local supplier initiatives, business development programs, local community grants and community development programs.

As a desktop only activity, this directory is limited to information available on the internet, which is incomplete. Mining companies generally only report comprehensively at a business level, rather than for each operation (with the notable exception of Anglo American). Some operation-level information can be

gleaned from news articles, media statement and case studies, but the level of information varies from site to site. Further, this directory does not include information about individuals. This could be added, depending on the needs of the user.

5 Conclusion

The framework is designed to be transferable to other regions. It provides a model of the engagement base needed to ensure that Indigenous interests are appropriately incorporated during planning for mine closure and post-mining land use, including repurposing. This pilot study has demonstrated that framing a stakeholder map with repurposing in mind generates a deeper and broader set of stakeholders than would normally be considered in an operational stakeholder map. A subsequent process would be needed to elicit the specific priorities, values and aspirations for development.

Although not undertaken for this pilot, this directory should be 'ground-truthed' with local Indigenous groups to ensure validity, uncover further resources, and provide opportunities for engagement. In many areas, this may be a valuable task for Indigenous groups to undertake, or lead, themselves, and could be combined with a process for outlining a community vision for development.

6 Summary

This Final Report has brought together a substantial volume of material in order to provide greater insights into post-mining land uses in Australia and the opportunity to produce better outcomes for the private sector, communities, governments and the national economy through repurposing. Through the review of published material, and most especially via the case studies, it has been made clear that the repurposing of mine sites is possible and may deliver substantial benefits – economic, social and environmental. It is also very apparent that the pathway to such positive outcomes is often challenging. Key hurdles to be overcome include:

- The impacts of government regulatory frameworks that prescribe outcomes not compatible with re-use;
- The nature and structure of the mining industry, with volatility in mineral prices adding uncertainty mine closure decisions and time frames;
- The isolated nature of many mine sites that are often distant from infrastructure and markets;
- The inability to identify a sustainable business opportunity arising out of a mine closure and this often results because mining industry personnel, and others lacking appropriate skill sets and experience, attempt to undertake this task;
- The inherent dangers embedded in mine sites, which may require significant management if the mine is to be used actively;
- The high cost of mining mine repurposing proposals; and,
- Limited understanding of the economic and social potential embedded in former mines. We have also identified a number of enablers of mine repurposing and these include:
- Leaders drawn from the community, the mining industry, other parts of the private sector or one of the tiers of government. These organisations and individuals need to act as champions of change and often play the most pivotal role. They also need to be able to articulate an agenda of change and positive outcomes;
- Existing infrastructure that may make possible developments that would not otherwise be possible;
- Collaboration across tiers of government, the private sector and the community;
    - Engagement with governments and/or the mining industry may be important, especially if they are willing to provide financial support for the transition. However, there is inevitably greater demand for such assistance than funds available;
- Early planning for post-mining land use; and,
- Access to markets and the ability to monetise the repurposing of a mine sites within a relatively short time frame.

Overall, there is much that is positive with respect to mine site repurposing in Australia in 2022, but the challenge remains to convert that potential into action on the ground.

7 Recommendations

This Final Report finds that while there is considerable potential to achieve more with respect to the repurposing of former mines in Australia and elsewhere, steps need to be taken to expedite that process. Mine site repurposing is possible for many more sites than occurs currently in Australia, but it is important to acknowledge that it is not feasible economically, socially or environmentally to do so in all instances. We recommend that further work be undertaken on four major themes, with each theme potentially calling for multiple lines of activity.

First, there is a need to develop and implement regulatory frameworks for the mining industry that are more open to mine repurposing. Other work being completed by CRC Time is investigating this issue, and this work needs to be disseminated widely and used to inform public and policy debate. There may, however, be a need to extend this work to have a clearer focus on the arrangements that would enable mine site re-use without transferring unacceptable risks to the public sector.

Second, there is a pressing need to better understand how key individuals and organisations make decisions about the end of mine life. Mining companies are, of course, a key decision maker and the choices taken by Executives and the Board will largely shape the range of possible outcomes. Clearly, some miners are more amenable to re-purposing and others are not, and this may reflect their perception of the risk and/or entrenched practices. Governments are also key decision makers and there is a need for greater transparency around their decision making processes and how they shape, interpret and implement legislation.

Third, the mining industry as a whole needs to find ways to promote the leadership of change at the end of a mine's life. The case studies included in this Final Report documented the ways in which leadership from diverse sources – the mining industry, other private businesses, governments and the community – was central to bringing about positive change.

Fourth, there is a need to develop assets that are more directive and informative about how to repurpose mines. These assets also need to be made available in diverse formats and targeted to a number of different audiences – the mining industry and those who consult on the topic, communities, governments etc. ICMM (2019) provides guidance on the repurposing of mines, but it necessarily remains at a high level, and it may be difficult to translate its recommendations to actions on the ground. The early section of this report argued that there is a pressing need to develop an approach to the repurposing of mines that allows for a greater degree if standardisation rather than the (expensive) development of bespoke solutions. Such an approach would offer much to the Australian community.

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