

Strategic Framework for Managing Abandoned Mines in the Minerals Industry



Ministerial Council on Mineral and Petroleum Resources





Strategic Framework for

Managing Abandoned Mines

in the Minerals Industry



Aim

To encourage a strategic approach to abandoned mines management, which promotes efficiency, sustainability, innovation and consideration of the unique assets and community values for each mine.

This publication was produced jointly by the Ministerial Council on Mineral and Petroleum Resources (MCMPR) and the Minerals Council of Australia (MCA). The MCMPR consists of the Australian Government Minister for Resources, Energy and Tourism, and state and territory ministers with responsibility for minerals and petroleum. The New Zealand Minister of Energy and the Papua New Guinean ministers for Mining, and Petroleum and Energy, have observer status. MCMPR's mission is to contribute to the national wellbeing by promoting the progressive and sustainable development of the Australian mining, minerals and petroleum industries, and to consult on the nation's energy needs, resources and policies. The MCA represents Australia's exploration, mining and minerals processing industries, nationally and internationally, contributing to sustainable development and society. MCA member companies produce more than 85 per cent of Australia's annual mineral output. The MCA's strategic objective is the advocacy of public policy and operational practice for a world-class industry that is safe, profitable, innovative, environmentally and socially responsible, and attuned to community needs and expectations.

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www.industry.nsw.gov.au

Department of Employment, Economic Development and Innovation (Queensland Government)

www.deedi.qld.gov.au

Department of Primary Industries and Resources SA (South Australian Government)

www.pir.sa.gov.au

Department of Mines and Petroleum (Western Australian Government)

www.dmp.wa.gov.au

Department of Infrastructure, Energy and Resources (Tasmanian Government)

www.dier.tas.gov.au

Department of Resources, Energy and Tourism (Australian Government)

www.ret.gov.au

Department of Primary Industries (Victorian Government)

www.dpi.vic.gov.au

Department of Resources (Northern Territory Government)

www.nt.gov.au/d

Minerals Council of Australia

www.minerals.org.au

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Australian Mining History Association

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Introduction

The mining industry makes a large contribution to Australia. However, standards have changed and some practices that were acceptable in the past are not today. Abandoned mines may represent a safety or environmental legacy, but they also provide a valuable insight into the cultural development in regional Australia.

Across Australia, there are thousands of abandoned mine sites of varying size and complexity. Each site is unique and may present a variety of environmental and safety risks, cultural values and future opportunities. Within each jurisdiction, there are a small number of sites that have significant liabilities; these require extensive input of resources and funding to achieve modern rehabilitation standards.

Context

For the purposes of this paper, the term ‘abandoned mine’ will be used to define mines where mining leases or titles no longer exist, and responsibility for rehabilitation cannot be allocated to any individual, company or organisation responsible for the original mining activities. Such sites are also called ‘derelict’, ‘orphan’, or ‘former’ mines. The term ‘abandoned mine managers’ refers to local, state or territory governments, mining companies or private landowners responsible for managing abandoned sites.

Strategies to minimise the likelihood of the creation of new abandoned mines, and to ensure adequate closure of current mines, are set out within the legislation that regulates these operations. Legislative requirements for mine planning (as an integral part of whole-of-mine-life planning) and financial securities (or rehabilitation bonds) have limited the likelihood of future liabilities being created by abandoned mines. However in many cases, the legislation that regulates operational mines has little or no effect once a mine has been abandoned, as there is no longer an entity liable for the site.

This framework deals with the management of abandoned mines.

Aims

The Strategic Framework for Managing Abandoned Mines aims to:

Promote a strategic approach to managing abandoned mines so that risks are minimised, sites are managed efficiently and sustainably, and the values associated with these sites are recognised.

Currently, each state and territory has developed its own approach to managing abandoned mine sites. The framework will promote convergence of these approaches across jurisdictions, to address issues such as:

- site inventories and site data management
- improved understanding of liability and risk relating to abandoned mines
- improved performance reporting
- the standardisation of processes and methodologies
- knowledge and skill sharing across jurisdictions.

Management of abandoned mines is a complex task requiring government, community and industry involvement and cooperation. Responsibility for managing abandoned mines rests with local governments, state and territory governments, and sometimes private land owners and industry.

Management options vary and are largely dependent on risks, resources available for rehabilitation and the desired end land use. A site may be rehabilitated to as close as possible to the original environment, but other rehabilitation options include making sites available for an agricultural land use, or considering for adaptive reuse, such as a heritage precinct or a waste management facility. Possible options will depend on the nature and location of the site.

The challenge for managers is to find innovative solutions for protecting the multiple values of abandoned sites, while ensuring that risks to public safety and the environment are managed appropriately. A particular challenge for abandoned mines management is to implement effective rehabilitation with limited resources. It is important to promote innovation and share experiences of success and failure.



The framework provides high-level guidance on issues to be addressed when managing abandoned mines. These issues are discussed in five chapters: valuing abandoned mines; data collection and management; risk assessment and management; resourcing and partnership opportunities; information sharing and 'leading practice'. Case studies highlight examples where leading practice management has resulted in environmental and social benefits, as well as innovative and sustainable reuse of abandoned sites.

Target audience

This framework is targeted at the following audiences:

- local, state and territory governments, mining companies or private landowners (collectively known as 'abandoned mines managers') with responsibility for managing abandoned sites and their rehabilitation
- abandoned mines managers and environmental officers with responsibility for assessing site risks and managing data
- private individuals, organisations and academics interested in understanding existing and emerging processes for abandoned mines management
- interested parties seeking to participate in or contribute towards, abandoned mines management.

Chapter 1: Valuing abandoned mines

Objective:

To recognise and promote the multiple values of abandoned sites.

Principles:

- Management should reflect the multiple values and risks of sites.
- Values may include historical, educational, social and environmental aspects.
- Future economic potential should be considered.
- Early and comprehensive community engagement is necessary.

Historically, abandoned mines have been considered to be legacies with safety risks, contamination and environmental impacts. More recently, the potential for positive uses of abandoned mine sites have been recognised and acted upon.

Abandoned mines managers have a stewardship role to ensure that the values of abandoned mine sites are conserved and any risks are reduced. Stewardship implies the consideration of available management and rehabilitation options so that the multiple values of abandoned mine sites are not adversely affected (MCMPR and MCA 2003).

In general, site management requires a balance between the values mentioned above and the opportunities they present. The nature of the balance between various values will depend on individual site features, site risks, the economic and community context of the mine, and the views of stakeholders and the community in relation to the site and its issues.



Historical, social, educational and environmental assets

Early mining activities led to the growth and development of a number of regional areas across Australia. For this reason, abandoned mines are often valued for cultural and social reasons, and can contribute towards providing a 'sense of place' for local communities.

Abandoned mine sites can offer a range of educational opportunities. As well as providing a perspective on regional social and economic development, abandoned mines often illustrate past mining methods and attitudes to the environment. Some sites provide valuable lessons on environmental impacts and environmental management.

Some abandoned mine sites also provide the earliest evidence of mining heritage in Australia. Mining heritage can highlight aspects of Australian technological, social and regional development. Items of heritage significance on abandoned sites require appropriate management and preservation. Indigenous, environmental and geological values are other important aspects of abandoned sites, which may be overlooked during site management. Development of appropriate rehabilitation options to conserve or manage these multiple values should occur in the rehabilitation planning phase. Stakeholder consultation is a fundamental part of identifying values and developing appropriate (and acceptable) management options.

Economic assets

A number of abandoned mine sites with previously uneconomic or unknown mineral resources have become economically viable mines through improved mining, exploration and metallurgical technologies. A common example is the reprocessing of tailings into an economic resource. It is important to acknowledge the future potential of these sites and plan accordingly when planning for management or rehabilitation.

In terms of future economic benefits, abandoned sites may also be viable for future opportunities such as:

- bio-banking (e.g. offset sites for biodiversity)
- potential sources of water (e.g. flooded underground workings or surface storages)

- academic and industry research
- investigating the potential of future innovative minerals exploration methods or extraction potential (including tailings re-processing)
- geosequestration
- entertainment and sport
- future industrial development
- farming and aquaculture
- tourism and recreational opportunities.

(Readers can also refer to Pearman 2009)

When assessing and ultimately managing an abandoned mine site, potential economic opportunities should be documented. This may also assist industry in identifying sites that may be suitable for funding or 'in-kind' contributions for management and rehabilitation.

Engaging stakeholders

Engaging stakeholders to assist in identifying the true value of an abandoned mine site (including environmental, social and economic considerations) can assist in developing appropriate management options for the site.

An open and transparent approach that involves stakeholders in the management and planning of a rehabilitation project can give stakeholders 'ownership' of the rehabilitation and help improve awareness about issues requiring management. Setting 'joint' rehabilitation goals, including key matters such as defining the future beneficial uses for a site, builds trust and improves stakeholder support for abandoned mine site projects.

There are examples in Australia and throughout the world where the multiple values of abandoned sites have been carefully considered, thus influencing the way a site has been managed. In South Australia, mining heritage on abandoned sites is an important tourism feature.

South Australia's mining heritage - a cultural tourism feature

The early history of economic development in South Australia was dominated by the discovery and development of mineral deposits, particularly copper. The mines of this early period were worked principally by Cornish immigrants who brought their own mining technology and left a cultural legacy unique in Australia.

Since the mid 1980s, conservation and interpretation at a number of historic mining sites, including Moonta and Burra, has generated significant interest in mining heritage, which now forms an important cultural tourism feature in South Australia.



Cornish mining landscape, Moonta Mines State Heritage Area

A network of self-guided walking trails, interpretive sites, drive trails and several mining museums have been established throughout the state. These sites offer historic and educational values to the local community who strongly identify with their mining past.

In 2006, the Cornwall and West Devon Mining Landscape was inscribed on the World Heritage List, to recognise Cornish mining's fundamental influence on world hard rock mining, ore dressing and, in particular, steam engine technology during the 19th century. During this time Cornwall developed a distinctive regional identity that took on global significance with mass migration of Cornish culture after 1840.



*Cornish mining landscape,
Burra Mine Historic Site*

The Australian Cornish Mining Heritage Site, which consists of the Burra and Moonta Mines State Heritage Areas, is currently being considered for National Heritage Listing and for the World Heritage Tentative List. This site contains the most authentic and historically significant components of a Cornish mining landscape in Australia for the period 1845 to 1923. The aim is to have the Australian Cornish Mining Heritage Site joined as a transnational World Heritage Listing, linking Cornwall, South Australia, Mexico, Spain and South Africa to the existing Cornish World Heritage Site. This would recognise that the distinctive mining landscapes in those locations were derived directly from the Cornish mining landscape.

Prepared by the Department of Primary Industries and Resources SA, Government of South Australia.

Preserving ecological assets, management of endangered bats in mine shafts

Management of derelict mines to improve subterranean bat habitats and minimise safety risks to the unsuspecting public is occurring more frequently in south-eastern Australia. Many mines around the world have had gates placed at mine and cave entrances as a means of maintaining bat habitat and preventing human access. A recent scientific assessment compared numbers, behaviour and the relative species abundance of two bat species (*Rhinolophus megaphyllus* and *Miniopterus schreibersii*) before and after gates were installed at two mines compared to two ungated (control) mines.

The stage of gate installation was found to influence bat behaviour in the short-term. Eleven days after the final installation there were no significant differences between the numbers of bats leaving gated and control mines, suggesting that the bats had learned to negotiate, after a short period of time, the types of gates used. Although no statistical difference could be detected, bat numbers in gated mines remained at half of pre-gating levels. Further research is required to improve gate designs and consider their applicability across other mines. Site-specific monitoring after gating is a further recommendation.

This research highlights that derelict mines can provide important habitat for the conservation of threatened species (*Miniopterus schreibersii* has a conservation status of 'vulnerable' in New South Wales). It is important to note that the way abandoned mines are managed can have significant (sometimes negative) implications for conservation outcomes.

Prepared by the Minerals Council of Australia with reference to the study by Slade and Law (2008).

Chapter 2: Data collection and management

Objective:

To promote the collection of quality data that enables effective assessment of risks and impacts.

Principles:

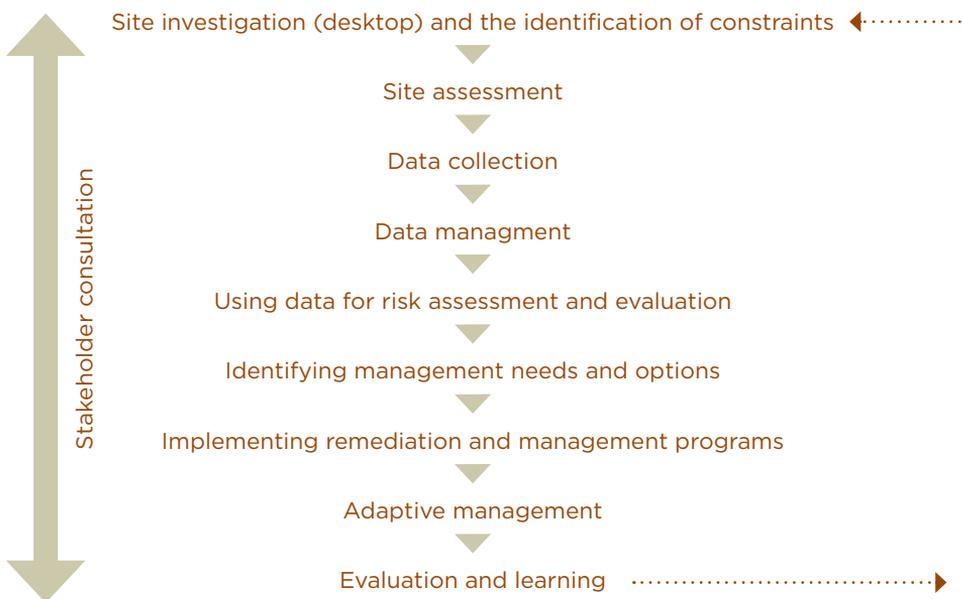
- Data collection is integral to the management of abandoned mine sites.
- Data collection systems should record the multiple aspects of abandoned mine sites.
- Data management should allow comparative analysis and reporting of information.
- Data need to be available to enable long-term identification and management of risks.

The management process

The effective management of abandoned mine sites depends on thorough planning and a clear and proven methodology for management.

Figure 2.1 sets out the key steps to follow in the management of abandoned mine sites.

Figure 2.1 A simple abandoned mines management process



It is important to understand the factors that can directly influence the management approach for an abandoned site. These shape the type and nature of information required, and include:

- regulatory requirements and planning instruments that apply to the site
- government policy for mine closure and abandoned mines management
- presence of conservation agreements or existing management plans
- heritage (Indigenous and non-Indigenous) issues
- the identification of stakeholders
- community considerations and the outcomes of past engagement strategies
- industry interests in the site and possible future economic potential
- site-specific constraints.

Site assessment and data collection

Site assessment (including site inspection), data collection and data management are perhaps the most important steps in the management process. Knowledge of site history can be an invaluable element in this process.

A comprehensive database, incorporating detailed site information, risk data and strategic planning information, is fundamental to the long-term management of abandoned mine sites. A well-designed system, together with focused and detailed data, allows comparative analysis within and between sites and promotes informed decision making for the short and long-term management of a site. It also provides a framework for a robust risk assessment.

Accurate risk and opportunity evaluation can occur when detailed data covering a range of issues relevant to abandoned mine sites is available. When gathering information about a mine site, key information relevant to the following management focuses should be recorded as a minimum:

- land management and access
- safety
- environment
- heritage
- socioeconomic issues
- residual mineralisation.

An initial step to improve the quality of abandoned mine site data is to develop a standardised structure whereby all managers are collecting consistent, detailed and useful information about abandoned mine sites. Such data collection enables comparative analysis and comprehensive reporting. Most importantly, such a structure allows risks and liabilities, as well as opportunities and assets, to be identified and prioritised for management.



Geographic information systems

Leading practice data systems incorporate geospatial references for the various types of abandoned mine site information collected. Geographic information system (GIS) map-based interfaces can be linked with existing local, state and national map interface systems to provide a spatial analysis of collected information. A map interface can be highly valuable for users who do not have a detailed knowledge of the site and the surrounding area. GIS is also a useful tool for comparative analysis and the effective management of large data sets.

There is a collective commitment from mine managers to improve methods in data collection and collation for abandoned mines. A proactive method for improving data collection and management is to share information about current ‘best-practice’ database structures including data types, GIS applications, reporting mechanisms and the relationships between them to promote informed decision making.

A number of state and territory governments have established systems that are available for the public to view. Public availability of key information enables the Australian public to be informed about potential hazards and other risks that may exist at these sites. Public communication of risks and opportunities increases the involvement of a wider range of stakeholders in the ongoing management of a site.

Western Australia's inventory of abandoned mine sites

In 1999 the Geological Survey of Western Australia (GSWA) began a program to accurately locate and document abandoned mine sites throughout the state. The inventory of individual mining-related features, such as shafts, open cuts, dumps and infrastructure, focuses upon high-priority sites that are close to towns and main roads and were in production before 1990. There are 11411 historic mine sites in GSWA's MINEDEX database and 4995 of these (44%) are categorised as a high priority for field data collection.



Geologist using a Cassiopeia hand-held personal computer in left pocket connected by cable to the Omnistar DGPS in the backpack. This configuration was used at the start of the project and performed satisfactorily, however it was bulky, and there were issues related to data management.

A database was designed and developed for the project after consultation with representatives from stakeholder groups. Mine site features are categorised into eight main groups, depending on a defined set of attributes or parameters. The feature groups include: underground, collapsed shaft, open cut, dump, shallow workings, rehabilitated, infrastructure, and, under infrastructure. The site location and date information is automatically input from the global positioning system. An extensive range of over 100 site attributes are available for recording including: dimensions, depths, orientation measurements, bund heights, photograph numbers and commodity.

The inventory of abandoned mine sites provides baseline data on historical mining-related features in Western Australia and can be used for future independent assessments of hazards,

Symbol hand-held personal computer with the attached external global positioning system and battery. This configuration has proved to be robust and reliable.



heritage value, and environmental impact. The database also provides a valuable contribution to the spatial distribution of mineralisation in historical mining areas.

The data were first released publicly in mid-2003. The sixth and latest edition of the 'Inventory of abandoned mine sites: progress 1999–2007' was released in March 2008. This comprehensive database contains a total of 189530 mine site features, 54030 digital photographs and a number of georeferenced GSWA historical maps and bulletins. Much of the data are now available to the public via an interactive webpage.

Symbol hand-held personal computer with the attached Links Point Global Positioning System (GPS) unit. This configuration was used briefly, but spare batteries were required for extended use and GPS performance was not always optimal.

Prepared by the Department of Mines and Petroleum, Government of Western Australia.

Use of key site data for long-term site management

Mount Morgan, Queensland

The Mount Morgan Mine site is a large historic gold and copper mine located near Rockhampton in central Queensland. This complex site is the largest site managed under Queensland's Abandoned Mines Land Program (AMLP), through the Department of Employment, Economic Development and Innovation (DEEDI) – Queensland Mines and Energy. The legacy to the state consists of 270 hectares of acid-producing waste rock dumps and tailings, a highly contaminated water-filled open cut pit, unsustainable water management and a heavily impacted downstream environment.

Rehabilitation planning for the mine site started in earnest in 2000. At that time, it was recognised that there were large knowledge gaps in regard to fundamental site processes, and baselines to measure rehabilitation success had not been set.



Mount Morgan Queensland mine site overview.

Given these issues, the project began a large number of baseline studies aimed at understanding the whole-of-mine environment, including safety, heritage and environment (including on-site and the impacted environment).

The acquisition and development of reliable environmental datasets was critical to understanding key risks and environmental processes fundamental to future management. Equally important was expert evaluation and application of acquired data. From this, an understanding was obtained of key site risks and processes critical to sustainable future management.

Applying site data was important in the development of key site management tools and concepts. These tools included site water balance, groundwater and surface water, contaminant source and loading models. From this, priority management risks were identified and the effectiveness of rehabilitation strategies could be assessed. Identified risks included a positive pit water balance, major pathways for contaminated seepage and geotechnical instability hazards within containment structures.

This process led to the development and implementation of major site management strategies to reduce geotechnical and environmental hazards, including seepage interception improvements, removal of unsafe dam structures, and the design and construction of a water treatment and release program.

The development of a sustainable long-term rehabilitation strategy for the site has relied heavily on the application of acquired data. In addition, understanding stakeholder's expectations was crucial to the development of major objectives for the rehabilitation plan completed in 2003.

Source and pathway characterisation has been crucial in identifying a sustainable rehabilitation strategy for the site and a priority sequence for works in line with potential funding allocations. Understanding the scale and type of available resources such as cover material has also been important in understanding strategy limitations and potential opportunities.

Prepared by the Department of Employment, Economic Development and Innovation, Government of Queensland.

Chapter 3:

Risk assessment and management

Objective:

To promote a risk assessment framework to allow comparative analysis and informed decision-making in abandoned mine site management.

Principles:

- Risk assessment is a key tool in decision making.
- Risk assessment is about identifying risks so they can be properly prioritised and managed.
- It should be carried out in conjunction with the identification of site opportunities as these may have risks of their own.
- Once risks are understood, the positive values of the site and its opportunities are better able to be realised.

Risk assessment is an integral part of abandoned mine site management. Risk assessment allows:

- the identification of hazards, risks and opportunities in abandoned mine sites
- the consequence (severity) and likelihood (probability) of risks to be analysed and compared
- development of risk mitigation measures and options based on priority
- transparent decision making regarding the management of sites and features
- a common framework for management decisions by multiple site stakeholders
- the transparent allocation of funds.



Consistent risk assessments allow accurate comparisons of risks onsite and between sites, and also influence how sites are prioritised for management. The process of assessing and managing risks provides mine managers with the tools to make the best available choices for the management of sites. The aim is to implement management options to make a site environmentally stable, safe, non-polluting and self-sustaining, while reducing the likelihood of negative events.

As highlighted in the previous chapter, an effective risk assessment program is dependant on a detailed data collection system. Identification of key risks early in the management process ensures that essential data is collected in the site assessment phase. Key risks may include, but are not limited to, safety of site and mine features, environmental issues (including impacts on flora and fauna), contamination, acid mine drainage, heritage, health and sociopolitical risks.

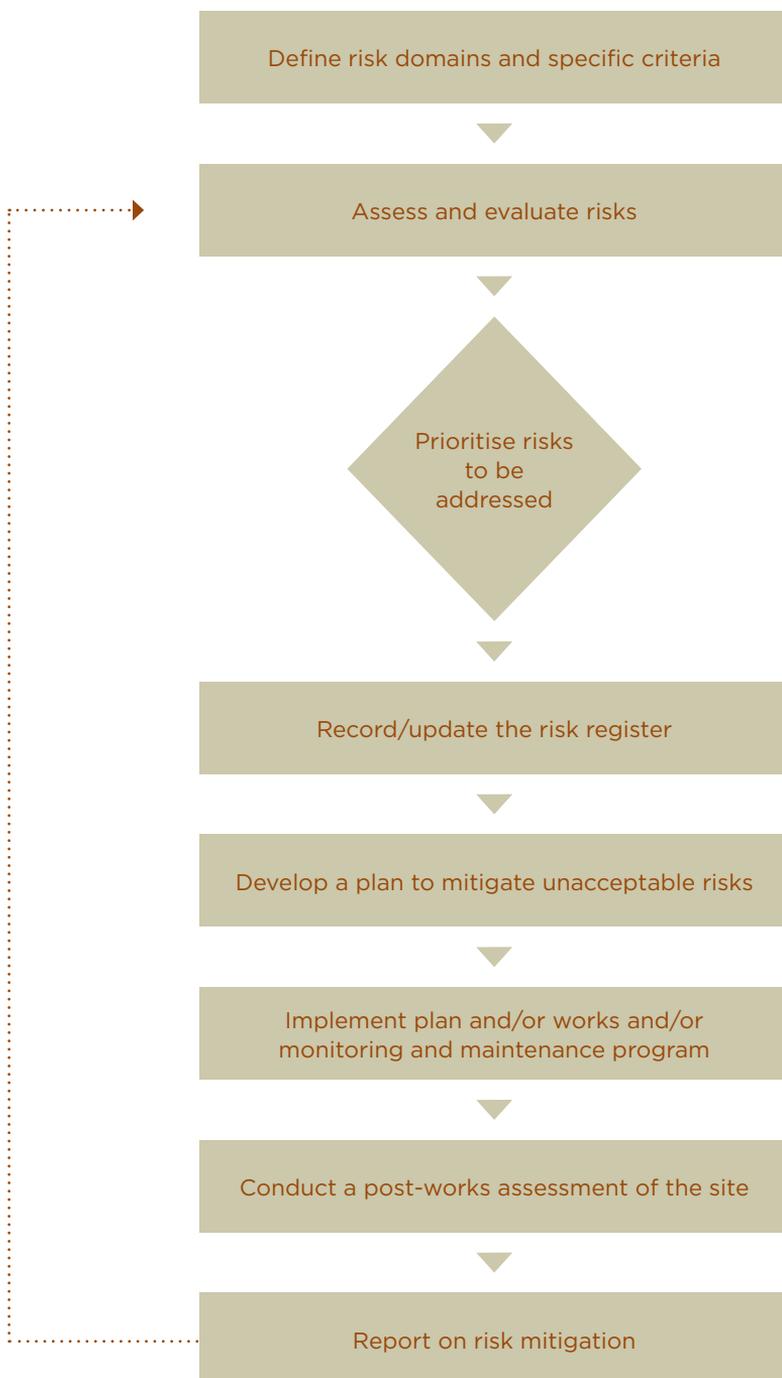
In developing a risk assessment and management system, assessment procedures should be developed in accordance with the Australian and New Zealand *ISO Risk Management - Principles and Guidelines* (AS/NZS ISO 31000:2009). Mine managers should also consult with interested and affected parties in the identification, assessment and management of all significant impacts (DRET 2008).

The risk assessment process should also incorporate works planning and reporting about risk mitigation. The process ideally should work as an adaptive management tool whereby risks are identified, ranked and then progressively managed on a priority basis. 'Managed' risks can then be re-assessed and re-ranked. An example process is shown in Figure 3.1.

Importantly, any risk assessment approach should be documented to ensure:

- transparency in the results
- consistency in the methodology and risk ranking/weighting (especially with qualitative assessments)
- appropriate review of risk assessment methodology after changes in time and circumstances (social, legal, legislative, after safety or environmental incidents occur, etc).

Figure 3.1 Example of a simplified risk assessment process



Risks and liability in abandoned mine site management in Queensland

Queensland has established an Abandoned Mine Lands Program (AMLP) to coordinate the management of abandoned mine sites. The AMLP has developed a methodology under which the liability to the state for these sites is reduced and managed within a risk assessment framework.

The broad aims of the Queensland AMLP are to:

- remove risks to public health and safety
- stabilise abandoned mine sites and reduce the impact of contamination, erosion and mass movement
- reduce impacts on the biological diversity of species in the vicinity
- remove or ameliorate sources of site contamination
- achieve an acceptable land use for the site compatible with rehabilitation strategies adopted
- improve the visual amenity of the site and its surrounding
- preserve cultural and indigenous values associated with any site.

These activities will directly reduce the state's liability for abandoned mines. This liability includes: ongoing costs associated with management of abandoned mines; significant public funding requirements to remediate legacy sites; exposure to personal injury claims from sites with public safety hazards; damage to reputation if poor decision making or inactivity is perceived; and environmental clean-up or remediation from uncontrolled releases.

The diversity of hazards, risks and potential liability varies significantly between abandoned mine sites. Assessments require a broad and equally diverse skill set to identify, qualify and quantify any issues at these sites.

The Queensland AMLP team is based in three regionally distant centres and, although small in total number, is a highly diverse and experienced group of professionals. The ability to share resources between centres allows the state AMLP to draw from a

pool of individuals with a broad range of qualifications and experience in abandoned mine-related issues. This state-wide sharing of skills is used to ensure the best people to address certain issues are placed within an AMLP project. This strategy reduces the risk of incorrect or incomplete risk assessments throughout the state.

The funding for remediation of sites under state responsibility is predominantly through publicly funded initiatives. As a result, the community expects the state to apply high standards of management to all projects and to leave the sites in a sustainable remediated state, free of any hazards and health risks and with minimal long-term management costs.

There are many thousands of abandoned mine sites in Queensland ranging from very isolated minor surface works to extensive, large and complex recent mining sites with significant legacies. The total funding available to the state AMLP to manage these sites is limited and the AMLP team must ensure that the highest risks are addressed through a prioritisation process, to ensure value for public funding and reduction of the state's liability.

In order to determine prioritisation for remediation or management, a means for determining the degree of liability to the state is undertaken through identification of the risks presented by a given site. Where possible, these risks are determined in a quantitative or semi-quantitative framework, while still allowing for other factors to be used in final consideration of the eligibility of a site for remediation.



Mount Oxide mine Queensland historic heap leach area before remediation

The concept of risk assessment of abandoned mine sites includes the prioritisation of sites using a risk management/due diligence technique. Assessments are made against a number of criteria, including:

- environmental
- heritage issues including the need to preserve mining, Indigenous and other cultural heritage
- economic
- social
- the ability to use residual resources contained on the site.

Where significant risks and liability for a site are identified, this may become a major project in its own right and the AMLP team would seek funding for remediation on a case-by-case basis.

Once a site is identified as a high priority, initial estimates of costs are investigated to reduce the risk to an acceptable level. The AMLP aim to ensure all works carried out on any given site are:

- as simple as possible
- practically achievable
- sustainable
- cost effective
- consistent if possible with adjacent land uses
- designed in a way that minimises the requirement for ongoing work.

It is important that the development of site remediation plans are undertaken in consultation with community and stakeholder groups where applicable. This allows for the confirmation of major problems or perceived issues at the site, identifies any benefits, opportunities or aspirations for the site by stakeholders, and allows for transparency within the decision-making process.

Prepared by the Department of Employment, Economic Development and Innovation, Government of Queensland.

Chapter 4:

Resourcing and partnership opportunities

Objective:

To promote resourcing opportunities for abandoned mines management and to increase partnerships.

Principles:

- Resources should be directed towards priority risks.
- Partnerships can provide innovative resourcing solutions, with mutual benefits and improved outcomes.

Given the limited resources available for abandoned mines management, resources should be directed towards the highest priority site risks that require management. There are opportunities for innovative funding/resourcing options, including partnerships, to increase the resources available for abandoned mines management. As well as bringing new resources, partnerships may bring new approaches and provide a sharing of the responsibilities for site management.

Before allocating resources towards abandoned mine projects, parties with responsibility for managing a site (or a group of sites) should conduct applied assessments to quantify and prioritise the risks. This process assists in allocating appropriate resources towards high-risk issues that require immediate attention and ongoing long-term management activities.



Resourcing options leading to beneficial outcomes

Once the costs of rehabilitating high-priority sites are estimated, resources to address these risks are required. The significant risks and large resource requirements to address issues at some abandoned mines can mean that considerable time is required to obtain the necessary funds (including, in some cases, the allocation of public funds) to manage them.

There are a number of successful resourcing options and rehabilitation arrangements that may be applied to produce sustainable and, at times, innovative management outcomes. Direct government funding, offset arrangements and partnerships can all be successful options for managing the risks on abandoned sites. Offsets, for example, are formal arrangements whereby industry may undertake safety, environmental or rehabilitation works at an abandoned mine site as part of the commitments made within the planning approval to mine within a lease. The suitability of this option would need to be reviewed on a case-by-case basis and formally approved with planning consent (where necessary).

Partnerships

Partnerships can contribute towards enhancing the ‘value for money’ on abandoned mine site projects. There are a number of different partnership types that offer various advantages. Partnerships have proven to be successful in improving the quality of rehabilitation projects, whilst allowing interested stakeholders to be directly involved in the rehabilitation.

Liability for works carried out at abandoned mine sites can be an obstruction to achieving partnerships that contribute to solving site problems. These considerations often relate to due diligence and ongoing responsibility for works that are conducted by partners. Solutions must consider individual site contexts.



Partnerships for abandoned mines projects may include:

- **Impacted stakeholder partnerships** — Impacted stakeholders are parties that are directly affected by rehabilitation works. These may include landowners, adjoining landowners, Indigenous groups and local communities. The benefits of these partnerships are that affected stakeholders and communities have high levels of participation, improving their ownership of the project. One common example for smaller projects is where a mine manager may undertake the major works and the impacted stakeholder assists by managing or performing parts of the project such as revegetation, fencing or ongoing maintenance.
- **Community/organisation partnerships** — This option may include partnerships with community groups such as Landcare, Rivercare, Heritage Societies and other local organisations. This type of partnership usually depends on the focus of the organisation. Many activities tend to be in-kind or undertaken for the cost of a donation to the organisation. Community involvement can also be a good source of information for identifying risks and planning rehabilitation where plans and records are not readily available (or up to date).
- **Government - government partnerships** — There are benefits and savings when government organisations work together to produce agreed outcomes. A streamlined and cost-effective rehabilitation project can result from combining management resources.
- **Government - industry partnerships** — Industry contributions towards abandoned mines projects can include project management services, environmental monitoring, community engagement and advice about planning/ approval processes or environmental management matters. With planning consent, some companies have also rehabilitated abandoned workings on mine leases to gain access to mineral resources.
- **Partnerships with private companies with economic interest in the mine** — A private company (not necessarily a mining company) may offer to rehabilitate a site so that the site can be used for a different and more productive end land use. An example is the rehabilitation of an abandoned mine into a waste disposal facility. The benefit of this resourcing option is that the site is used for another productive purpose, rather than forever remaining an abandoned mine.

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- **Academic partnerships** — Encouraging students or academics to conduct studies at abandoned mine sites can generate up-to-date information for use in rehabilitation planning or site monitoring programs. Such partnerships also bring knowledge of cutting edge techniques that may be able to address issues for which there are no effective standard solutions.

It is important to examine the effectiveness and applicability of each partnership type before any steps towards confirming the partnership are made. The roles of each partner also need to be defined clearly (through a legal agreement where necessary). Early confirmation of timeframes/deadlines and expectations regarding outcomes is essential. All parties should also have their contributions formally recognised or promoted.

Minerals Council of Australia/Tasmanian Minerals Council – Savage River case study

Grange Resources (Tasmania) Pty Ltd owns and operates the Savage River Mine in northwest Tasmania. The terrain is rugged and mountainous, and covered with dense rain forest. The mine and concentrating plant are both in the Savage River valley, with the Savage River flowing through the mine site and ultimately discharging into the Pieman River, which then flows westwards to the coast.

The Savage River Mine was originally operated as an open cut magnetite mine from 1966 until 1996. During this time four pits were mined, creating ten waste rock dumps and two tailings dams. Acid drainage was noted in the last 10 years of the operation, leading to elevated concentrations of heavy metals downstream of the mine. A study of the downstream effects of the mine in 1995 found that up to 90% of the major taxa (families) of aquatic macroinvertebrates and up to 99% of the macroinvertebrate abundance had been eliminated in some sections of the Savage River, which was effectively depauperate for 20 kilometres downstream.

Before the mine was re-opened in November 1997, the Tasmanian Government developed and implemented the Goldamere Agreement and the *Goldamere Pty Ltd (Agreement) Act 1996* with the new owners. This legislative and administrative framework established the Savage River Rehabilitation Project. Funds for the remediation were provided by both the purchase money and the closure funds left by the original owners. Because these funds were orders of magnitude below that needed to normally fund a remediation project of this nature, the Tasmanian Government and the new owners initiated and implemented a cooperative management and remediation regime that allows for both parties to benefit.

The Goldamere Agreement allows the mine owners to undertake remediation contracts for the Crown to ‘work off’ the purchase price. The Goldamere Act provides the mine owners with indemnity against pollution caused by previous operations both existing and that which may occur in the future. Where pollution is caused or might be caused by previous operations and this may be impacting on Grange’s operations or discharges, Grange is indemnified against that emission and the state



Savage River — helicopter view of Savage River Mine

cannot set emission limits. Grange is however required to operate to best practice environmental management. The agreement and legislated indemnity means that Grange can actively configure its mine and waste planning activities to maximise remediation benefits without fear of future litigation for past mistakes.

Effective and innovative acid rock drainage (ARD) management has been a cornerstone of Grange's ability to secure a long-term future for the operation and to unlock the potential within the magnetite resources of the region. ARD management strategies undertaken by Grange in conjunction with the Savage River Rehabilitation Project include the use of monitoring to evaluate the extent of the problem, the mapping and segregation of waste rocks by type to minimise treatment of pyritic wastes, the use of climate appropriate innovative storage techniques to exclude water and/or oxygen from high sulphide waste rock landforms, and the use of magnesite and calcite chlorite schist rocks to provide a source of alkalinity for the neutralisation of acid drainage.

The Savage River Rehabilitation Project has been working to reduce the metal loads from the site since 1997 and has achieved toxicological water quality targets in medium and high river flows since 2000. The result is that fish species are now being seen within the mining lease at low cost to the community. A long-term partnership between a mining company and a government is producing long-term dividends for both parties.

Prepared by the Tasmanian Minerals Council.

Mole River, an example of successful government partnerships

The Mole River Arsenic Mine is located 34 kilometres west of Tenterfield in northern New South Wales. The mine was the second largest production site for arsenic products in New South Wales up to its closure in 1940. Whilst works were carried out in 2002, studies by Nguyen et al (2006) from the University of Queensland concluded that the site is 'still very unstable' and that 'potentially large amounts of water soluble arsenic species could be discharged into surrounding ecosystems by chemical and mechanical weathering'. Water testing showed that contaminants from the site were found in the nearby Mole River.



A photo of the chimney at Sunny Corner Mine. Mining activities at Sunny Corner Mine occurred between 1875 and 1922, and again in 1949. Sunny Corner was the first major silver deposit to be exploited in New South Wales and gold, copper and lead deposits were also mined intermittently in the mine's early years. The chimney was built in the 1890s and continues to be an interesting heritage feature at the mine.

The Derelict Mines Program (DMP) is administered by the Department of Industry and Investment and manages mine sites where no company, organisation or individual can be found to be responsible for the rehabilitation of a site. Due to the contamination risk, the Mole River Arsenic Mine was prioritised for works by the DMP.

The Border Rivers - Gwydir Catchment Management Authority (CMA) have a charter to improve the health of water catchments. In 2007-2008, under their Point Source Pollution Incentives, the CMA prioritised funds towards a rehabilitation project at Mole River. The CMA was aware of the risks posed by the Mole River Arsenic Mine and was keen to support remediation of the site.



Rehabilitation of the Mole River Arsenic Mine, near Tenterfield, New South Wales.

The mine site contained a number of significant heritage features and a Section 139 Exemption was granted from the New South Wales Heritage Branch to allow the rehabilitation works to proceed. A works program was jointly developed by the DMP and the CMA. A core aim of the works was to improve the water quality leaving the site while effectively managing the significant heritage items.

The rehabilitation plan resulted in improvements to surface drainage and the prevention of the movement of contaminants by encapsulating contaminated material on site. All disturbed areas were revegetated to ensure surface stability. The works were completed in August 2008 for a total cost of \$360,000 (excl. GST, which included a CMA contribution of \$150,000).

Monitoring to date has shown a significant increase in surface stability and an improvement in water quality leaving the site.

Prepared by Department of Industry & Investment, Government of New South Wales.

Chapter 5:

Information sharing and ‘leading practice’

Objective:

To share ‘leading practice’ management information for abandoned mines.

Principles:

- It is important to share rehabilitation successes and failures.
- Sharing information about management approaches and methodologies helps to promote continuous improvement.

It is important to recognise that there are many successful and efficient methods for rehabilitating abandoned sites to make them safe, stable, non-polluting and sustainable. As these management techniques evolve with improvements in knowledge and technologies, there are opportunities to further strengthen the management of abandoned mines by sharing this important information. Sharing information about successful rehabilitation approaches and methodologies contributes towards continuous improvement for abandoned mines management. The communication of failures (lessons learned) is also necessary to ensure that past mistakes are not repeated.

Opportunities for significant advancement in the way that management information is shared should also be realised. Sharing information and efficiencies, by way of meetings, workshops and technical documents, will bring the strengths of mine managers, including government and industry, together into an accessible forum.



Interactive websites, wikis and blog sites are other effective communication mediums. Proactive communication strengthens the management of abandoned mines and ensures that 'leading practice' methods do not remain isolated to a particular locality.

Communities are increasing their focus on environmental management and rehabilitation standards for mining and other mineral resources activities throughout Australia. For this reason, it is imperative that stakeholders and communities are not only made aware of the efforts to achieve higher standards of abandoned mines rehabilitation, but that they are also directly involved in managing the various issues that abandoned mines present. At a local level, engaging stakeholders is pertinent to determining appropriate rehabilitation objectives for a site and examining the range of possible future beneficial land uses. Together, stakeholders and mine managers can shape the future management of abandoned mines in Australia so that sites continue to provide values to communities as they once did in the past.

An important need in abandoned mines management is changing the way that people have traditionally viewed sites. Abandoned mines management is as much about identifying opportunities, as it is about identifying risks. Proactive engagement and improved communication of management techniques promotes sustainable long-term management and inclusiveness in the ongoing stewardship of abandoned mines.

Supporting documentation

References

Australian Standard/New Zealand Standard *AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines*.

Bell LC(ed) (2003) *Proceedings of the workshop on Management and Remediation of Abandoned Mines 14 November 2003 Brisbane Queensland*. ACMER, Brisbane.

Department of Industry, Tourism and Resources (DITR) (2006). *Leading Practice Sustainable Development Program for the Mining Industry - Mine Rehabilitation*, DITR, Canberra.

Department of Resources, Energy and Tourism (DRET) (2008). *Leading Practice Sustainable Development Program for the Mining Industry - Risk Assessment and Management*, DRET, Canberra.

Ministerial Council on Mineral and Petroleum Resources and Minerals Council of Australia (2003). *Strategic Framework for Tailings Management*, MCMPR and MCA Canberra.

National Orphaned/Abandoned Mines Initiative NOAMI (2006). *Workshop Proceedings - Orphaned and Abandoned Mines, A Workshop to Explore Best Practices - Winnipeg, Manitoba October 2006*. NOAMI, Ontario.

Pearman G (2009) *101 Things to do with a Hole in the Ground*. Post-Mining Alliance in association with the Eden Project, Boldelvag Cornwall.

Slade C and Law B (2008). An experiment test of gating derelict mines to conserve bat roost habitat in southeastern Australia. *Acta Chiropterologica* 10:367-376.



Useful guidelines and websites

Australian History Mining Association – www.mininghistory.asn.au

Australian Government Department of Industry, Tourism and Resources (2006). *Leading Practice Sustainable Development Program for the Mining Industry - Community Engagement and Development*, DRET, Canberra.
www.ret.gov.au/sdmining

Eden Project – www.edenproject.com

International Union for Conservation of Nature, International Council on Mining and Metals and Post-Mining Alliance (2008). *Roundtable on Restoration of Legacy Sites - Roundtable Report*. March 2008 Conference, Toronto.

Ministerial Council on Mineral and Petroleum Resources (2005). *Principles for Engagement with Communities and Stakeholders*, MCMPR, Canberra.
www.ret.gov.au/resources/mcmprr/pages/strategicframeworks/

National Orphaned Abandoned Mines Initiative (2003). *Lessons Learned on Community Involvement in the Remediation of Orphaned and Abandoned Mines. Case Studies and Analysis*, NOAMI Ontario.

