

Strategic Framework for Mine Closure

**Australian and New Zealand Minerals and Energy Council
Minerals Council of Australia**



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Introduction

The concepts and standards underlying mine rehabilitation and closure today are much more demanding and stringent than they were just a few years ago and reflect changing public priorities and environmental imperatives. The Australian mining industry fully accepts the concept and responsibility of minesite rehabilitation and decommissioning. At issue is the development of an effective and efficient approach to the funding of closure that enables mine rehabilitation and other environmental objectives to be achieved and also facilitates and encourages industry to comply with the requirements of Government and the community.

Mine rehabilitation is an ongoing programme designed to restore the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post-mining land users (WMI, 1994). The objective of mine closure is to prevent or minimise adverse long-term environmental impacts, and to create a self-sustaining natural ecosystem or alternate land use based on an agreed set of objectives.

More recently, the emphasis for management of the environmental aspects of mine closure and decommissioning has shifted towards the idea of “planning for closure” (Sassoon, 1996). Mine closure is a continuous series of activities that begins with pre-planning prior to the project’s design and construction and ends with the achievement of long-term site stability and the establishment of a self-sustaining ecosystem (WMI, 1994). Not only will the implementation of this concept result in a more satisfactory environmental conclusion, but it can also reduce the financial burden of mine closure and rehabilitation.

The objective of this *Strategic Framework for Mine Closure* is to encourage the development of comprehensive Closure Plans that return all mine sites to viable, and wherever practicable, self-sustaining ecosystems, and that these plans are adequately financed, implemented and monitored within all jurisdictions.

The Strategic Framework

This *Strategic Framework for Mine Closure* has evolved as a cooperative development between the Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Australian Minerals Industry (represented by the Minerals Council of Australia (MCA)). It is designed to provide a broadly consistent framework for mine closure across the various Australian jurisdictions.

The Strategic Framework is not a detailed set of guidelines for mine closure. It is anticipated that both government and industry will develop complementary regulations and guidelines to further advance the process of effective mine closure. It is hoped that these initiatives will reflect, and further develop, the principles outlined in this document.

The Strategic Framework is designed to cover a broad range of mining and mining related activities. Exploration (which entails lower levels of impact and is often transitory in nature) and mineral processing are considered part of the broader mining function. While it is acknowledged that the focus of the Strategic Framework is primarily on improving closure related activities at operating mines, the principles are relevant to a broad range of activities.

The Strategic Framework does not address the issue of abandoned mines. Historically, mine sites have not been rehabilitated to standards that would be considered acceptable today. While acknowledging the importance of this issue, it was considered more important to address existing mines in an attempt to limit future problems.

Structure of the Report

The *Strategic Framework for Mine Closure* is structured around a set of objectives and principles grouped under six key areas (stakeholder involvement, planning, financial provision, implementation, standards and relinquishment). The principles are summarised at the beginning of the report, and then expanded on in subsequent sections.

The Strategic Framework also contains a number of Boxes which are designed to amplify particular topics which, in the authors' opinion, required additional explanation. The treatment of these topics is not exhaustive, but is provided as additional guidance.

The Strategic Framework concludes with a listing of Supporting Documentation which includes Standards and Guidelines, References and Definitions. The inclusion of the list of definitions is an attempt to standardise the often confusing and ambiguous terminology surrounding the closure debate.

Regulatory Setting

Regulation to meet growing community expectations of environmental management is increasing in all Australian jurisdictions. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, which came into effect in July 2000, has established a new and nationally consistent framework for environmental assessment of new projects and variations to existing projects, based on consultative agreements between the Commonwealth and State and Territory Governments. Issues related to mine closure are an important consideration in the assessment process for mining proposals.

Appropriate planning and adequate provision for mine closure are issues to be addressed by both the regulators and the minerals industry across Australia. Australian State and Territory Governments (and in some cases local government) are responsible for the regulation and management of mine closure and rehabilitation requirements on industry. All States and Territories have mine closure policies requiring site-specific post-mining rehabilitation plans developed by companies for approval by the respective mining agencies in each jurisdiction. State and Territory Governments also require some form of security bond, usually in the form of a bank guarantee or a cash payment for smaller operations, but the calculation process for bonds varies between jurisdictions.

For its part, the mining industry has responded directly to changing community environmental standards through the development of mechanisms such as the Australian Mining Industry (2000) *Code for Environmental Management* and through the adoption of international environmental performance standards such as ISO 14001. The Code encourages self-regulation by the industry, with mine closure as a key component, to:

- ensure resources are adequate to implement environmental plans during operations and closure; and
- plan for closure in the feasibility and design phases of a project and regularly reviewing plans to consider changes in site conditions, technology and community expectations.

This *Strategic Framework for Mine Closure* is intended to promote a nationally consistent approach to mine closure management in all Australian jurisdictions. It will not necessarily result in identical legislation in each State and Territory. But it will establish principles for mine closure that are agreed between regulating authorities and the mining industry, and which can be applied with greater consistency to the development of regulations by government and mine closure programmes by industry.

Objectives and Principles

Stakeholder Involvement

Objective

To enable all stakeholders to have their interests considered during the mine closure process.

Principles

1. **Identification** of stakeholders and interested parties is an important part of the closure process.
2. **Effective consultation** is an inclusive process which encompasses all parties and should occur throughout the life of the mine.
3. A **targeted communication strategy** should reflect the needs of the stakeholder groups and interested parties.
4. **Adequate resources** should be allocated to ensure the effectiveness of the consultation process.
5. Wherever practical, **work with communities** to manage the potential impacts of mine closure.

Planning

Objective

To ensure the process of closure occurs in an orderly, cost-effective and timely manner.

Principles

1. Mine closure should be **integral** to the whole of mine life plan.
2. A **risk-based approach** to planning should reduce both cost and uncertainty.
3. **Closure plans** should be developed to reflect the status of the project or operation.
4. **Closure planning** is required to ensure that closure is technically, economically and socially feasible.
5. The dynamic nature of closure planning requires **regular and critical review** to reflect changing circumstances.

Financial Provision

Objective

To ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability.

Principles

1. A **cost estimate** for closure should be developed from the closure plan.
2. Closure cost estimates should be **reviewed regularly** to reflect changing circumstances.
3. The **financial provision** for closure should reflect the real cost.
4. **Accepted accounting standards** should be the basis for the financial provision.
5. **Adequate securities** should protect the community from closure liabilities.

Implementation

Objective

To ensure there is clear accountability, and adequate resources, for the implementation of the closure plan.

Principles

1. The **accountability** for resourcing and implementing the closure plan should be clearly identified.
2. **Adequate resources** must be provided to assure conformance with the closure plan.
3. The **on-going management** and monitoring requirements after closure should be assessed and adequately provided for.
4. A closure **business plan** *provides the basis for implementing the Closure Plan.*
5. The **implementation** of the Closure Plan should reflect the status of the operation.

Standards

Objective

To establish a set of indicators which will demonstrate the successful completion of the closure process.

Principles

1. **Legislation** should provide a broad regulatory framework for the closure process.
2. It is in the interest of all stakeholders to develop **standards** that are both acceptable and achievable.
3. **Completion criteria** are specific to the mine being closed, and should reflect its unique set of environmental, social and economic circumstances.
4. An agreed set of **indicators** should be developed to demonstrate successful rehabilitation of a site.
5. **Targeted research** will assist both government and industry in making better and more informed decisions.

RELINQUISHMENT

Objective

To reach a point where the company has met agreed completion criteria to the satisfaction of the Responsible Authority.

Principles

1. A **Responsible Authority** should be identified and held accountable to make the final decision on accepting closure
2. Once the completion criteria have been met, the company may **relinquish** their interest.
3. **Records** of the history of a closed site should be preserved to facilitate future land use planning.

MINE CLOSURE

1 Stakeholder Involvement

It is generally agreed that, in principle, public involvement in mining-related decision-making and management processes is an important factor in enhancing the legitimacy of the industry, in developing public trust in the ability and desire of mining companies to conduct their business in an environmentally responsible manner, and in improving the quality of the decisions being made regarding environmental management (WMI, 1994).

In response to public concern, governments are encouraging, and in some cases requiring, companies to discuss their plans and the environmental results of their activities (from exploration, through development and operation, to closure) in an open and forthright manner (WMI, 1994). More effective approaches to environmental management can be developed, and the public trust in mining enhanced, when the community and other stakeholders are fully informed and participate in the closure process.

The benefits of a successful stakeholder consultation process include:

- improved planning decisions;
- better motivated staff;
- improved relations with government;
- better acceptance of closure decisions;
- enhanced public image and reputation; and
- improved community receptiveness to future mining proposals.

Objective: to enable all stakeholders to have their interests considered during the mine closure process.

1.1 Stakeholder Identification

Identification of stakeholders and interested parties is an important part of the closure process.

Stakeholders are those parties with the potential to be affected by the mine closure process. They are distinct from Interested Parties, who have an interest in the process or outcomes of mine closure. Identifying key stakeholders and interested parties, and developing a good relationship with them, is fundamental to a successful closure process [see **Box 1 – Stakeholder Groups**].

Box 1 Stakeholder Groups

Stakeholders fall into three broad categories, the company, the community and the State. Outlined below are some of the key sub-groups within these broad stakeholder categories, however, the list is not exhaustive and will vary with individual circumstances.

The Company

Key company stakeholders include:

- *Employees*: employees facing job loss have an obvious and immediate stake in mine closure.
- *Management*: in order to promote continuity of corporate knowledge and consistency of approach to the post-mine rehabilitation and closure process, it is important that selected managers and company environmental personnel be encouraged to continue their involvement beyond the cessation of production.
- *Shareholders*: shareholders need to be fully informed of their company's obligations for closure.

The Community

The impacts of closure on the community will vary with the degree of community dependence on, or interest in, the mining project and its environmental issues. In some cases, the community will not survive the loss of the mine. At a community level, consultation is also important to avoid building up false expectations about the outcomes of closure. Significant community stakeholders include:

- *Local business and service providers*: the economic effects of mine closure on local business and service providers may be severe, and consultation is important to assist them in their own planning for the transition.
- *Landholders, neighbours and nearby residents*: this group may be physically affected by the closure and may have particular needs and desires that can be incorporated into rehabilitation planning.
- *Local government*: in addition to their direct involvement with the mining operation, local government provide a vital link with the community. Early consultation and planning is essential to minimise disruption to community services.
- *NGOs and Community Groups*: these groups often represent different points of view to those elements in the community which are physically and/or financially affected by mine closure.

The State

The requirements of government agencies must be satisfied if relinquishment is to be achieved. Consultation with these agencies is essential to ensure that rehabilitation and closure plans satisfy regulatory requirements. Important government stakeholders include:

- *The Responsible Authority (and other regulators)*: a key role of the Responsible Authority is to coordinate the functions and needs of other government agencies with accountabilities in the area.
- *The land management agency*: where the land management agency (current or future) differs from the Responsible Authority, there is a need to ensure that their requirements are an integral component of the closure process.
- *Other government agencies*: the potential effects of closure on the community and individuals may necessitate consultation with government agencies, such as community welfare and employment, that have not previously impacted on the mine management.

1.2 Effective Consultation

Effective consultation is an inclusive process which encompasses all parties and should occur throughout the life of the mine.

The process of consultation should begin early in the mine life, preferably during the planning phase, and continue into the closure and relinquishment phase. Consultation should not be on a selective basis, but should involve all parties with a stake in the project and the post-mining land use. Other parties, such as conservation organisations and other non-government organisations, may have an interest in the project and should be included in the consultation process. To be effective, communication must involve listening and feedback, as well as informing. Consultation is about both perception and reality (EPA, 1995), and perceptions can only be gauged by listening to the affected stakeholders and interested parties.

1.3 Targeted Communication Strategy

A targeted communication strategy should reflect the needs of the stakeholder groups and interested parties.

Closure information distributed to stakeholders should be provided in a timely and coordinated manner, and when a response is requested, adequate time should be provided (WMI, 1994). This is particularly important when infrastructure is being retained for community use, where post-mining land use involves community input, or where the post-mining land use is different from the pre-existing land use. Effective community relations demands that the corporation, its personnel and sub-contractors, have the capacity and desire to bridge the cultural and capacity gaps that often separate them from local communities (Dunn, 2000).

1.4 Adequate Resources

Adequate resources should be allocated to ensure the effectiveness of the consultation process.

To be effective, consultation presupposes corporate commitment and should be taken seriously by all company representatives involved. Proper mine closure is the result of a combination of innovative concepts, long-term commitments, and multi-party cooperation (Mudder & Harvey, 1998). The objective should be to ensure that all stakeholders have the necessary information and resources to participate meaningfully in the closure process.

1.5 Working with Communities

Wherever practical, work with communities to manage the potential impacts of mine closure.

Mine closure often causes significant social concern, particularly in local communities where a mine may be the major commercial activity (WMI, 1994). To minimise the impact on these local communities it is essential that companies work with them to manage such impacts. During the life of the mine it may be possible to encourage and assist the development of community cooperative industries which can persist after closure. Local industries that have a broader focus than the mine could also be supported. Working with communities through community consultative committees will assist in the development of programmes to offset the inevitable changes that will occur at closure.

2 Planning

Proper planning for closure should come during the feasibility study, design and permitting phase of a mine, and be upgraded during operational life. The lack of an up-to-date mine closure plan can result in severe environmental and economic consequences (Mudder & Harvey, 1998).

The broad aims of closure planning are to:

- to protect the environment and public health and safety by using safe and responsible closure practices;
- to reduce or eliminate adverse environmental effects once the mine ceases operations;
- to establish conditions which are consistent with the pre-determined end land use objectives; and
- to reduce the need for long-term monitoring and maintenance by establishing effective physical and chemical stability of disturbed areas.

Objective: to ensure the process of closure occurs in an orderly, cost-effective and timely manner.

2.1 Integration

Closure should be integral to the whole of mine life plan.

Mine closure should not be an “end of mine life process” but should be integral to “whole of mine life” if it is to be successful. Planning for closure should commence at the feasibility phase of an operation. In this way, future constraints on, and costs of, mine closure can be minimised, post-mining land use options can be maximised and innovative strategies have the greatest chance of being realised.

2.2 Risk-based Approach

A risk-based approach to planning should reduce both cost and uncertainty.

Current trends in closure planning involve technical review and analysis of risk and cost benefit in both engineering and environmental terms. The advantages of a risk-based approach to closure planning lie in the quantification of subjective factors and the analysis of uncertainty related to both design performance and cost (Morrey, 1999). The objective of a risk-based approach is to reduce both cost and uncertainty.

2.3 Closure Plans

Closure plans should be developed to reflect the status of the project or operation.

At least two types of closure plan will be required through the life of a mine; a Conceptual Closure Plan (project phase) and the main Closure Plan (operations phase) [*see Box 2 – Closure Plans*]:

- a Conceptual Closure Plan for use during feasibility, development and detailed design; and
- a Closure Plan for use during construction, operation and post-operation [*see Box 3 – Typical Contents of a Closure Plan*].

2.4 Closure Feasibility

Closure planning is required to ensure that closure is technically, economically and socially feasible.

Being able to successfully close a mine is critical to project approval. It is necessary to ensure that closure is technically, economically and socially feasible without incurring long-term liabilities. These issues are initially addressed in the Conceptual Closure Plan, which should include preliminary land use objectives to ensure that closure concepts are factored into final project design.

2.5 Regular and Critical Review

The dynamic nature of closure planning requires regular and critical review to reflect changing circumstances.

The Closure Plan should be modified as a result of any operational change, new regulations or new technology, and should be comprehensively reviewed on a regular and pre-determined cycle (eg. every 3 to 5 years). It should always remain flexible enough to cope with unexpected events. The Plan should include the management of social as well as environmental issues.

Box 2 Closure Plans

Conceptual Closure Plan

A Conceptual Closure Plan identifies the key objectives for mine closure to guide project development and design. It should include broad land use objectives and indicative closure costs. (This does not preclude land use objectives being varied during the mine life to reflect changes in both knowledge and technology.)

Closure Plan

Closure planning includes a commitment to progressive rehabilitation and detailed plan development and implementation. A number of subsidiary plans need to be developed as the Closure Plan evolves. These typically include: a rehabilitation plan, a decommissioning plan and a maintenance and monitoring plan.

- *Rehabilitation plan:* A key component of the Closure Plan is a commitment to progressive rehabilitation. In conjunction with an active research and trials programme, this may assist in minimising ongoing contamination and reduce final costs by confirming or modifying completion criteria and demonstrating that they can be met. Progressive rehabilitation allows best use of available personnel and equipment and should assist in minimising required security deposits.
- *Decommissioning plan:* As a detailed component of the Closure Plan, a decommissioning plan should be developed towards the final stages of an operation. (As the exact date for ceasing production is rarely known, it is suggested that the decommissioning plan be developed 2 to 4 years prior to estimated cessation.) Once established it should be updated annually. The decommissioning plan include such things as: details of the demolition and removal or burial of all structures not required for other uses; removal, remediation or encapsulation of contaminated materials; and the procedures for making safe and sealing, openings to underground workings.
- *Maintenance and monitoring plan:* The last aspect of the Closure Plan is performance monitoring, which should be designed to demonstrate that the completion criteria have been met. This period should also plan for remedial action where monitoring demonstrates completion criteria are unlikely to be met. If progressive rehabilitation has been successful, with stabilisation and revegetation meeting completion criteria this last phase of closure may be shortened. It is, however, unlikely to be less than 5 years in duration.

Box 3 Typical Contents of a Closure Plan

The development of a Closure Plan needs to take into account both the legal requirements and the unique environmental, economic and social properties of the operation. Outlined below are the typical contents of a Closure Plan, which will vary depending on individual circumstances. In developing the Closure Plan, the following four key objectives should be kept in mind:

- to protect the environment and public health and safety by using safe and responsible closure practices;
- to reduce or eliminate environmental effects once the mine ceases operations;
- to establish conditions which are consistent with the pre-determined end land use objectives; and
- to reduce the need for long-term monitoring and maintenance by establishing effective physical and chemical stability of disturbed areas.

Closure Plan: typical contents of a Closure Plan (not a minimum requirement or template):

- Introduction & Project Description
 - Land tenure
- Objectives of Closure
- Baseline Environmental Data
- Legal & Other Obligations
 - Key statutes & regulations
 - Responsible Authority
 - Regulatory instruments
- Stakeholder Involvement
 - Stakeholder identification
 - Community consultation
- Risk Assessment
 - Existing legacies
 - Future risks
 - Cost/benefit analysis
- Closure Criteria
- Closure Costs
 - Provisions
 - Securities
- Closure Action Plan
 - Human resources/responsibilities
 - Progressive rehabilitation
 - Decommissioning
 - Remediation
 - Geotechnical assessment
 - Landform establishment
 - Revegetation
 - Aesthetics
 - Heritage
 - Health & safety
 - Post-closure maintenance & monitoring
 - Survey (remaining structures & areas of contamination)
 - Documentation/reporting/records
- Tenement Relinquishment

3 Financial Provision

It is in the best interest of an active mining operation to develop and periodically review and update the closure plan and to modify its internal accrual process so that unexpected costs do not occur at the beginning of decommissioning. More emphasis is being placed not only on the internal accrual process but also on the external bonding requirements. In order to reduce further public intervention into the accrual and bonding aspects of a mining operation, there needs to be a commitment to conduct these periodic assessments in a realistic manner (Mudder & Harvey, 1998).

It is essential that the cost of closure be estimated as early as possible. Without a realistic closure cost the feasibility study cost estimate will be inadequate, and project viability will not be adequately tested. Closure costs will, of necessity, be indicative only, but can be based on broad industry experience.

Securities should not be offset against provisions. Securities are quite separate from any internal accounting provision.

Objective: to ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability.

3.1 Cost Estimate

A cost estimate for closure should be developed from the closure plan.

Closure plans provide cost estimates for progressive rehabilitation and final closure activities, as well as for environmental monitoring and long-term site management. The closure cost estimate provides a technical basis for the value of closure funds required, and can be estimated reasonably accurately provided there is sufficient site-specific information and data (Anderson *et al.* 1999).

3.2 Regular Review

Closure cost estimates should be reviewed regularly to reflect changing circumstances.

Costs should be reviewed regularly (eg. annually) to adjust for inflation and closure work requirements, and undergo thorough re-assessment on a regular and predetermined cycle to account for changing community standards and expectations. Return on sale of assets or salvage value are difficult to predict, particularly at remote locations, and should not be used to offset the cost of closure.

3.3 Financial Provision

The financial provision for closure should reflect the real cost.

Mine closure takes place when there is typically no return from the operation and there may be little value in the remaining assets. The objective of providing a financial provision is to ensure that adequate funds are available at the time of closure.

A schedule for financial provision should be part of all closure plans. The amount provided for rehabilitation should be consistent with the degree of disturbance at any given time. The provision is typically accrued over the life of the operation, and may be varied to reflect changes in mine planning and operations.

3.4 Accepted Accounting Standards

Accepted accounting standards should be the basis for the financial provision.

The relevance of closure costs for financial stewardship reporting purposes is recognised by the accounting profession [see **Box 4 – Accounting for Provisions**]. Generally accepted accounting principles and practice require companies to use the accrual basis of accounting to match revenues with associated expenses (WMI, 1994). The objective should be to ensure that at the end of mine life, when income has ceased, there is sufficient accounting provision to cover the often significant mine closure expenditure.

3.5 Adequate Securities

Adequate securities should protect the community from closure liabilities.

Most modern approvals require some form of security to protect the State and/or community from liability [see **Box 5 – Types of Securities**]. The most important variables are the form and amount of the surety, and the requirements for obtaining partial and full release of the surety (Williams, 1993). During mining, assurance levels should be subject to periodic reviews, in order to allow regulators to adjust operators' assurance amounts upward or downward as clean-up needs, environmental risks, or economic factors dictate (Da Rosa, 1999).

Box 4 Accounting for Provisions

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International accounting practices for restoration and rehabilitation costs vary from no recognition of a liability to full recognition. There is no specific International Accounting Standard dealing with the costs of closing a mine, but this issue, and the recognition of provisions in general, is being addressed by International Exposure Draft E59 - Provisions, Contingent Liabilities and Contingent Assets and a number of very similar national exposure drafts.

The three most commonly used methods are:

- expense as incurred
- incremental method
- full liability method.

Expense as incurred

Using this method you expense all costs as they are incurred. You can justify this because at the end of the mine's life, you can sell any fully written-down assets, and re-work waste piles, slag heaps and tailings dams to provide cash surpluses. In many cases this surplus offsets the cost of restoration.

Alternatively, costs that were known to be incurred after the cessation of production are provided for in the concluding periods (say the last 5 years) of productive operations when the costs can be determined with more certainty.

We do not recommend this method because it is not in accordance with the principles of the international framework. We also note that this method has not been commonly used in recent years.

Incremental method

Using the incremental method you can accrue closure costs by gradually increasing the provision over the life of the mine. The practice of estimating the future cost of restoration and then building up to that cost over the life of a mine by making periodic provisions (the 'incremental' or 'rateable recognition') is adopted by many mining entities and grew out of conservative provisioning practices based on the matching concept.

The main objective of this approach is to ensure that the full liability is accrued at the end of the life of mine and closure costs are allocated equitably to the periods of operation. The liability is often small, in particular in the early stages of mining, so only limited disclosures are generally provided.

Full liability method

Using the full liability method, you provide for the total present value of the future cost of repairing past damage and other related shut down costs as soon as the commitment is incurred, and the amount capitalised under this method is amortised over the life of the mine. This method is not in common use.

A slightly different method is used in strip-mining, where restoration is required shortly after mining is completed in particular areas. In these cases you can make an accrual during production for the cost of restoration of mined-out areas. If restoration costs are incurred at a similar rate to production (and not significantly in arrears), you can treat these restoration costs as part of production costs when incurred.

Box 5 Types of Securities

In a survey conducted for the International Council on Metals and the Environment (ICME), Miller (1998) identified many types of surety.

“Performance guarantees have been used in the mining industry for several years. In recent years, however, governments have extended the concept of financial security much to include cradle-to-grave environmental performance. They have also experimented with different forms of financial assurance.

Financial surety instruments are guarantees issued by a bonding company, an insurance company, a bank, or another financial institution which agrees to hold itself liable for the acts or failures of a third party. Fidelity bonds, surety bonds, performance bonds and letters of credit are examples of this class of instrument. Today, the most common use of environmental surety instruments is to guarantee environmental performance after closure (through the funding of mine site reclamation or rehabilitation).”

4 Implementation

Well planned closure programmes consist of two distinct sequential phases; planning and implementation. Coordinating these stages will result in a well-designed, systematic, safe and cost-effective mine closure (Hordley, 1998).

The following considerations need to be taken into account in the management and implementation of Closure Plans:

- accountability for plan implementation;
- the resources needed to assure conformance with the plan; and
- on-going management and monitoring requirements after closure of the operation.

Objective: to ensure there is clear accountability, and adequate resources, for the implementation of the closure plan.

4.1 Accountability for Closure

The accountability for resourcing and implementing the closure plan should be clearly identified.

In theory, closure is the converse of commissioning, requiring similar skill levels, operational experience, motivation and commitment (Hordley, 1998). The closure process will be enhanced if there is a dedicated team structure, reporting to a project manager. Roles and responsibilities need to be clearly established.

4.2 Adequate Resources

Adequate resources must be provided to assure conformance with the closure plan.

Provisioning is designed to ensure that adequate funds are available to meet closure commitments. If the estimated provisions are inadequate to meet commitments, funds will need to be provided from other sources.

4.3 On-going Management

The on-going management and monitoring requirements after closure should be assessed and adequately provided for.

It should be the objective of all mine closure programmes to achieve a final land use which is maintenance free. However, under some closure scenarios (such as treatment of acid mine drainage) there may be a need to provide long-term, active management and/or monitoring of the closed site. The post-mining management and monitoring requirements need to be assessed and adequately provided for.

4.4 Closure Business Plan

A closure business plan provides the basis for implementing the Closure Plan.

A closure project should be managed as a self-funding operation, complete with comprehensive business plan, including costs, revenues, profit/loss and cash flows (Hordley, 1998). The development of a business plan provides the basis for measuring progress and highlighting any changes needed to the closure process, and should also include a schedule of actions, responsibilities, resources and timeframes.

4.5 Closure Implementation

The implementation of the Closure Plan should reflect the status of the operation.

Closure may be initiated in a number of different scenarios [see **Box 6 – Closure Scenarios**], including: planned closure, sudden closure, temporary closure and maintenance and monitoring.

Box 6 Closure Scenarios

Planned Closure

Planned closure involves the preparation of a Conceptual Closure Plan, and the timely evolution from it of the Closure Plan. When developed, the Closure Plan is based on the current level of bio-physical and socio-economic information, and mine planning and development detail. As the Project advances, the Closure Plan should be regularly updated and refined to reflect changes in mine development and operational planning, and environmental conditions. Planned closure requires the preparation of a decommissioning plan some years prior to closure, and the systematic implementation of this plan.

Sudden (Unplanned) Closure

In the event of sudden or unplanned closure, an accelerated closure process will need to be implemented. This involves the immediate preparation and implementation of a decommissioning plan (based on the pre-existing Closure Plan), taking into account the site's non-operational status. Where provision accounts are inadequate to fund the full closure requirements, funds will need to be provided from other company sources.

Temporary Closure (Care & Maintenance)

As a result of economic or operational circumstances, it is possible that mining and/or milling activity may cease and the operation will shut down on a temporary basis. A temporary shutdown of this nature is normally planned and assumes that the operation will recommence. The care and maintenance process involves the immediate preparation and implementation of a decommissioning plan, taking into account the potential for future operations at the site. It is recommended that where possible, and economically sensible, rehabilitation should be undertaken on all disturbed areas, even if it is likely that some of these areas will be disturbed in the future. Site remediation, and works to prevent potential off-site contamination, should be implemented as if for a final closure scenario. A temporary closure should always trigger a review of the final Closure Plan, which will be required to be implemented if circumstances remain adverse to the reopening of the operation.

Management & Monitoring

Provision should be made in closure planning for an adequate period of maintenance and monitoring. Monitoring should be designed to demonstrate that completion criteria have been met and that the site is safe, stable and has achieved the land use objectives set during the planning process. It is unlikely that such conditions can be demonstrated in less than 5 years following cessation of mining. Of particular importance is the development of support mechanisms for the maintenance and monitoring phase, when operational support (accounting, maintenance, etc.) is no longer readily available.

The need for maintenance recognises that not all closure strategies will be initially successful. All closure situations are unique, and although past experience and good planning can minimise the risks of failure, some remedial activity will usually be necessary. Where the opportunity exists to relinquish tenement progressively this should be taken.

5 Standards

Current site rehabilitation standards focus on effective covers and long-term stability of dams, dumps and other structures. Insufficient attention is being directed to the establishment of sustainable ecosystems as a long-term goal (WMI, 1994). The issue of developing guidelines or standards for closure purposes needs to be addressed. Where possible appropriate standards should be developed that provide benchmarks against which to measure performance.

Completion criteria are an agreed set of environmental indicators which, upon being met, will demonstrate successful rehabilitation of a site. Completion criteria are specific to the mine being closed, and reflect the unique set of environmental, social and economic circumstances of the site. They should be developed and agreed with stakeholders and, where possible should be quantitative and capable of objective verification.

Criteria need to be established to enable closed-out sites to be returned to the State on an equitable and cost-efficient basis to both government and industry while ensuring long-term protection of the environment (WMI, 1994).

Objective: to establish a set of indicators which will demonstrate the successful completion of the closure process.

5.1 Legislation

Legislation should provide a broad regulatory framework for the closure process.

Closure related legislation should be non-prescriptive and objectives based, and should ensure that all reasonable and practicable measures are taken to protect and restore the quality of the environment. It should be clearly understood and accepted that the legislative requirements are the minimum standard required, which best practice should exceed wherever possible.

Statutes are often proclaimed in response to bad practice, public outrage or some catastrophic failure. It is in the interest of all parties to avoid the introduction of reactionary and prescriptive legislation that so often follows such events.

Future State and Federal legislation should be framed with the following objectives:

- to provide a clear and transparent process;
- to be accessible to, and to protect the interests of, stakeholders through effective consultation;
- to be non-prescriptive and specify objectives to be attained; and
- to have enforceable powers.

5.2 Standards

It is in the interest of all stakeholders to develop standards that are both acceptable and achievable.

There are a number of means to achieve this, including the establishment of Codes of Practice and the setting of industry standards.

Codes of Practice are extremely powerful tools that can be developed for a range of issues or aspects of environmental management (eg. the Australian Minerals Industry's *Code for Environmental Management*). They can be voluntary or compulsory depending on the desired purpose and should be the basis on which industry sets its own standards. Industry standards can be established at a national or regional level as a basis for the development of more detailed company or site-specific standards. They provide a opportunity for validation through broad exposure and input from a wide range of operations. They should form the basis on which industry is judged, both by their peers, stakeholders and interested parties.

5.3 Completion Criteria

Completion criteria are specific to the mine being closed, and should reflect its unique set of environmental, social and economic circumstances

Completion criteria are the basis on which successful rehabilitation is determined, and should be developed in consultation with stakeholders. This ensures that there is broad agreement on both the end land use objectives and the basis for measuring the achievement of that objective. Ideally, completion criteria should reflect the specific environmental and socio-economic circumstances of the site.

Completion criteria should be flexible enough to adapt to changing circumstances without compromising the agreed end objective. This provides certainty of process and outcome (relinquishment of tenement when the conditions have been met). There should be an agreed process for the periodic review and modification of completion criteria in light of improved knowledge or changed circumstance.

5.4 Environmental Indicators

An agreed set of indicators should be developed to demonstrate successful rehabilitation of a site.

As the agreed end land use may take years or even decades to achieve, a set of specific performance indicators should be developed to measure progress in meeting the completion criteria. Correctly chosen, the environmental indicators will show whether the ecological processes which will lead to successful rehabilitation are trending in the right direction. This will enable early intervention where trends are not positive.

5.5 Targeted Research

Targeted research will assist both government and industry in making better and more informed decisions.

One of the challenges facing all stakeholders is making rational decisions with limited information or knowledge on which to base these decisions. It is in the interest of all parties to be involved in this process to ensure there is a balanced outcome and that the relevant issues are addressed.

For sound environmental decisions to be made in relation to mine closure:

- all stakeholders need access to high quality, relevant, and unbiased information grounded in sound science; but
- complete scientific certainty is not a prerequisite to appropriate action to protect the environment where there is a risk of serious adverse impact.

It is imperative that all the stakeholders look beyond the short-term gains and commit to the longer-term industry wide strategic research. This should be designed to provide knowledge and information on which future decisions are made, and should be supported at all levels in industry and government. In many cases there will be an altruistic expectation that the larger better resourced sectors will provide the lead in these matters. Where decisions are made with limited knowledge and assumptions this should be acknowledged and commitments freely and openly made to verify the assumptions and to research the appropriate answers.

6 Relinquishment

Despite the magnitude and complexity of mine closure, over time most operators will be able to satisfy their obligations under Federal and/or State regulations. The expectation is that the Responsible Authority will accept the operator's performance and release the surety, and accountability will revert to the State or a subsequent land owner. However, while it is one thing to expect to be released from mine closure obligations, it is quite another to expect to be discharged from further liabilities under broad environmental and civil laws (Williams, 1993).

Objective: to reach a point where the company has met agreed completion criteria to the satisfaction of the Responsible Authority.

6.1 Responsible Authority

A responsible authority should be identified and held accountable to make the final decision on accepting closure.

The Responsible Authority (usually State Department of Mineral Resources or equivalent) will make a judgement on the achievement of the agreed completion criteria after consultation with other involved regulatory agencies, including the future land controller. All release criteria are predicated on the prescribed or agreed post-mining land use.

A sufficient period of time should have elapsed to demonstrate the stability of the site. For revegetated areas, this may require verification that the vegetation is, or is trending towards, a self sustaining status. Potential impacts on groundwater may also take several years of monitoring to establish or refute.

The site should not endanger public health and safety, should alleviate or eliminate environmental damage, and allow a productive use of the land similar to its original use or an acceptable alternative. A site requiring active maintenance is unlikely to be acceptable to government agencies. Release of securities and bonds may be progressive, and reflect the progress of rehabilitation. To facilitate this process, Governments may wish to consider additional incentives for timely completion of closure commitments.

6.2 Relinquishment

Once the completion criteria has been met, the company may relinquish their interest.

When the Responsible Authority has agreed to relinquishment of the site, the management and maintenance of the site would rest with subsequent owners or the State.

Successful closure may preclude certain post-mining land uses. Where land uses are recognised as incompatible with any fragility in the rehabilitated site, these must be recognised and prohibited by either covenants on the title or by local government land zonings. Failure of rehabilitation due to faulty land management practices by the post-mining land user will not impose any retrospective liability on the mining company.

6.3 Record Retention

Records of the history of a closed site should be preserved to facilitate future land use planning.

In the past, when mines have closed and the tenure has been relinquished or surrendered, many of the records of activities that occurred on the sites have been lost, destroyed or inadvertently disposed of. These records, while potentially of no further use to the company that once operated the site, are valuable to governments and potential future land users (and stakeholders).

The retention of mine records is important because they provide:

- a history of past developments;
- information for incorporation into state and national natural resource data bases; and
- the potential to improve future land use planning and/or site redevelopment.

Box 7 Types of Records

Prior to relinquishment or surrender of tenure, records of the site development should be submitted to the Responsible Authority. The types of records required by the Responsible Authority will vary, however, it should include the following:

- geological records, including cores or core logs;
- plans and surveys of surface and underground developments and facilities;
- mining, milling and production records;
- locations, quantities and qualities of stored waste products (eg. tailings dams, waste dumps, etc.);
- site specific surveys or studies (eg. contaminated site survey); and
- design and specifications of final landform construction and rehabilitation.

These records are invaluable to any potential redevelopment of the site, particularly in assessing the suitability of proposed future land uses that are not consistent with the agreed future land use at the time of mine closure.

Supporting Documentation

Standards and Guidelines

ANZMEC (1995) *Security Deposit Systems for Minesite Rehabilitation*. ANZMEC Report No: 95.01.

Australian Minerals Industry (2000) *Code for Environmental Management*.

Environment Protection Agency (1995) *Community Consultation and Involvement*. Best Practice Environmental Management in Mining, Commonwealth of Australia.

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Environment Protection Agency (1995) *Rehabilitation and Revegetation*. Best Practice Environmental Management in Mining, Commonwealth of Australia.

ISO (International Standards Organisation) (1996) *Environmental management systems - Specification with guidance for use*. ISO 14001.

Minerals Council of Australia (1999) *Mine Closure Policy*.

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Definitions

Abandoned Site: an area formerly used for mining or mineral processing, where closure is incomplete and for which the title holder still exists.

Agreed: a standard or level of performance which must be to the satisfaction of the relevant Responsible Authority

Closure: a whole of mine life process which typically culminates in tenement relinquishment. It includes decommissioning and rehabilitation.

Completion Criteria: an agreed standard or level of performance which demonstrates successful closure of a site.

Consultation: a process of interactive and responsive communication.

Contaminated: refers to a condition or state, which represents an actual or potential adverse health or environmental impact because of the presence of any potentially hazardous substance.

Decommissioning: the process that begins near, or at, the cessation of mineral production and ends with removal of all unwanted infrastructure and services.

Environmental Indicator: a parameter (or a value derived from a parameter) which provides information about an environmental phenomenon

Exploration: the search for mineral deposits up to discovery and includes the delineation of the deposit by means of drilling and sampling.

Inactive Site: a mining or mineral processing area which is currently not being operated but which is still held under some form of title. Frequently such sites are referred to as being under “care and maintenance”.

Interested Party: a person, group or organisation with an interest in the process of, or outcome of, mine closure.

Landholder: the owner of freehold land, the holder of leasehold land, or any person or body who occupies or has accrued rights in freehold or leasehold land.

Mine: an area of land subject to some form of activity associated with the extraction and processing of minerals.

Mining Activity: activity whose purpose is the extraction, concentration and/or smelting of economic minerals from a mineral deposit. It includes exploration, development of mineral deposits, construction of the mine and mining (i.e. extracting and processing the ore) and closure.

Orphan Site: an abandoned mine for which a responsible party no longer exists or can be located.

Post-mining Land Use: term used to describe a land use which occurs after the cessation of mining operations.

Provision: a financial accrual based on a cost estimate of the closure activities.

Reclamation: as for rehabilitation, but specifically refers to the restoration of residual landforms following cessation of mining.

Rehabilitation (Reclamation): the return of disturbed land to a stable, productive and self-sustaining condition, after taking into account beneficial uses of the site and surrounding land.

Relinquishment: formal approval by the relevant regulating authority indicating that the completion criteria for the mine have been met to the satisfaction of the authority.

Remediation: to clean-up or mitigate contaminated soil or water.

Responsible Authority: any Government body empowered to approve activities associated with the closure process.

Safe: a condition where the risk of adverse effects to people, livestock, other fauna and the environment in general has been reduced to a level acceptable to all stakeholders.

Security: a financial instrument lodged with the responsible authority which is adequate to cover the estimated cost of closure.

Stable: a condition where the rates of change of specified parameters meet agreed criteria.

Stakeholder: a person, group or organisation with the potential to be affected by the process of, or outcome of, mine closure.

Standard: a document that prescribes the requirements with which the product, service or function has to conform.

Temporary Closure (Care and Maintenance): phase following temporary cessation of operations when infrastructure remains intact and the site continues to be managed.

Tenement: some form of legal instrument providing access to land for the purposes of mining.