

MINE CLOSURE AS A FRAMEWORK FOR SUSTAINABLE DEVELOPMENT

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Introduction

Historically, when an ore body was exhausted, production ceased and mines were boarded up and abandoned. Today it is accepted that mine closure requires the return of land to a viable post-mining use, such as agriculture. It is not even sufficient to simply physically reclaim mined lands anymore as the socio-economic impacts of the closure must also be assessed and managed.



Figure 1. The closed, but unrehabilitated, Kabwe lead zinc mine and smelter in Zambia. Unemployment in the town of Kabwe has reached epic proportions.

A mine is often the primary provider of income, employment and services in a local economy. The closure of the mine thus has significant impacts on the well-being of the community. This impact is more extreme in developing countries where local government lacks capacity to structure a development process that would provide alternative economic opportunities (World Bank, 2003).

At least 25 major mines in developing countries are expected to close during this decade (World Bank, 2002) (see table 1 for expected Southern African closures). This problem is particularly acute in mature mining countries: the number of operating coal mines in South Africa has declined by more than half, from 112 in 1986, to 53 at the end of 2000¹ (Mohring *et al.*, 2001).

To close a mine successfully, a trilateral consultation and problem solving process is required between mining companies, governments and communities. This process needs to commence at the design stage of the project. If conducted effectively, closure

¹ Mine closure is an important reason for the reduction in numbers of operating mines, together with the ongoing consolidation of the domestic industry, in the form of mergers and acquisitions.

can be the mechanism by which capital generated through mineral extraction is transferred to future generations. The World Bank (2002) lists three requirements for this:

- early, constructive action by mining companies to ensure that the memory of mining is not one of negative environmental and social impacts – a reputation that will increasingly threaten future mining operations elsewhere,
- proactive involvement by local communities to ensure that the benefits from mining are sustainable for future generations, and
- legal frameworks, with early planning and support to local communities by government, to ensure that the authorities are not left to manage large environmental and social problems.

Table 1. Anticipated major mine closures in Southern Africa the next ten years (World Bank, 2002).

<i>Country</i>	<i>Site</i>	<i>Mineral</i>	<i>Mining Company</i>	<i>Closure</i>	<i>Employment</i>
Namibia	Namdeb	Diamonds	DeBeers	2010	
Namibia	Navachab	Gold	AngloGold		
South Africa	Free State	Gold	AngloGold	2002	2,400
South Africa	Ergo	Gold	AngloGold	2004	1,270
South Africa	Bambanani	Gold	AngloGold	2005	6,130
South Africa	Savuka	Gold	AngloGold	soon	3,680
South Africa	Great Noligwa	Gold	AngloGold	2009	9,650
South Africa	Namaqualand	Diamonds	DeBeers	2010	2,181
South Africa	Tau Lekoa	Gold	AngloGold	2008	3,600
South Africa	Tau Tona	Gold	AngloGold	2011	5,260
South Africa	Tshepong	Gold	AngloGold	2012	3,870

The safety, environmental and social risks arising from badly conducted mine closure can result in significant liabilities for mining companies. For communities, closure can cause severe distress because of the threat of economic and social collapse. Abandoned mines may result in large clean-up costs and closure liabilities for governments (World Bank, 2002).

Diversity of species is a key characteristic of natural ecosystems. These ecosystems, in turn, form the basis of all ecosystem goods and services upon which sustainable livelihoods and food security depend (Tewary *et al.*, 1996). Historically, the mining sector has not recognised this, and mining activities have often resulted in destruction of or radical alterations to, whole ecosystems. In such cases, full recovery of these ecosystems and their components may take many years, possibly even millennia (Cooke 1999). Consequently, the impacts on the biophysical environment caused by the mining and minerals processing industry have frequently been accompanied by a significant loss of biodiversity. Current best practice attempts to avoid negative impacts and, where necessary, to restore impacted environments. This is an essential step if the

sector is to contribute significantly towards sustainable development in the region (Hoadley *et al.*, 2002).

Closure in a Developing Country Context

Prior to the passing into law of the Minerals Act (Act 50 of 1991) many mining companies “used irresponsible mining methods with no regard towards protecting the environment and had often shirked their responsibility towards environmental rehabilitation by leaving an area unrehabilitated prior to them being liquidated or leaving the country” (Swart, 2003).

Witbank: Spontaneous combustion, subsidence and acid mine drainage as the legacy of poor closure practice

The old, abandoned Transvaal and Delagoa Bay colliery (T&DB), in Witbank appears relatively normal at first sight. On closer inspection, sink holes associated with *in situ* combustion of coal are evident. Bare patches are present around the sinkholes and gases are vented to atmosphere.

The operation closed before rigorous closure practice was common and the former owners are no longer traceable. Rehabilitation of the site, now the responsibility of the state, may cost up to R100-million (Witcomb, pers. comm., 2001).

The colliery began operating towards the end of the 19th century. Fires soon began, but were controlled while the mine was still operational. Since closure in 1953, the fires have been out of control and in 1995, flames could be seen above ground.

The 750 ha colliery site lies between the township of KwaGuqa and the industrial area of Ferrobank. Footpaths crisscross it, passing close to burning areas. Underground fires are not the only problem at the site. Acid water decants into the nearby Brugspruit. A R30-million treatment plant has been established to treat this water but there are doubts about its effectiveness.



Figure 2. Water pollution arising from T&DB, an abandoned coal mine near Witbank.



Figure 3. Surface collapse due to abandoned burning workings at T&DB.

Post-mining regeneration priorities for South Africa, in the light of the country's developmental context, include:

- restoration of land surface of sufficient quality to support pre-mining land use potential,
- restoration of the ecological function of mined land and in the case of previously degraded land, the ecological function must be improved,

- efficient alternative use of mine infrastructure should be encouraged where this can be economically justified; where no economic alternative uses exist, mine infrastructure must be removed and the site rehabilitated to pre-mining condition,
 - Southern Africa in general, and South Africa in particular, experiences water shortages and therefore minimisation of current and potential future impacts on water quality and supply is imperative,
 - Job creation through education and stimulation of economic activity,
 - development projects to enable equitable participation in post mining economies by all members of the community, especially marginalized groups,
 - enhancement of leadership capacity within the community and local government may be required to ensure that development continues post closure,
 - skills and literacy training for community members.
- (Cooke & Limpitlaw, 2003).

Planning

Elements of Good Mine Closure Planning (World Bank, 2002)

This should commence in the design phase and should contain the following:

- times and costs,
- specifics about the expected final landform and surface rehabilitation, including detoxification of dumps and removal of plant,
- risk assessment to help prioritisation,
- cost-benefit analysis of different options,
- management plan for implementation of closure, and
- post-closure monitoring proposals.

This plan should be integrated with annual mine plans.

There are several ways in which mines can create socio-economic development opportunities for the local community. To promote sustainability these mining benefits must continue after closure (van Zyl *et al.*, 2001). A number of mines contribute to adjacent communities by providing or subsidising schools, clinics, hospitals, community centres or activities, self-help schemes, roads, houses or sports facilities (Cooke & Limpitlaw, 2003). A good example of this is Richards Bay Minerals with their current mining operation on the north coast of Kwa-Zulu Natal. While many mining development projects contribute to the economic development of an area beyond the mine boundaries, they are often

primarily implemented to ensure production. Economic benefits from these activities may therefore accrue only to a small part of the population and create “islands of development”. When it comes to closure many of these facilities collapse and are not sustainable (Kapelus, pers. comm., 2001).

Mine closure planning should be linked in with local economic development (LED) plans. Linkage with the planning framework of local government, integrated development plans (IDPs), can ensure that post mining land uses are compatible with surrounding development initiatives. This broader view provides a context against which the investments of the mine in human capital and infrastructure can meet local/regional development needs and create a mechanism for economic growth post closure.

Mine closure planning should:

- be conceived at the beginning of the life of the mine,
- not lead to a culture of community dependency,
- involve partnerships between mining companies, trade unions, the government, and civil society, and
- have the financial and human capital to manage the plans as required especially after mine closure,

(Cooke & Limpitlaw, 2003).

In South Africa, with 40% unemployment, it is a major challenge to create an economy and provide jobs for retrenched mine workers. The case study of Placer Dome, below, illustrates the need for major financial investment and senior management's commitment to company programmes for assisting retrenched miners (Cooke & Limpitlaw, 2003). It is often difficult to identify alternative opportunities for retrenched people in dispersed rural areas (Choshi, 2001).

Case Study: Placer Dome – South Africa (Choshi, 2001)

In April 1999, Placer Dome Inc, a leading multi-national mining company become the largest Canadian investor in the South African mining industry. This company bought a 50% interest in the South Deep Mine in the Witwatersrand basin. Soon afterwards it was faced with financial burdens. Gold price fluctuation and significant capital expenditures forced the company to reduce the workforce at South Deep by 35% - equivalent in social impacts to a partial closure of the mine.

A total of 2,567 workers were retrenched between July and October 1999. The company launched the Care Project to address the social and economic needs of the retrenched workers and their communities. The key components of this project include registration of the retrenchees, counselling, re-training and a micro-finance strategy to provide fledging entrepreneurs with seed capital. At corporate level, the commitment to ensuring that the project succeeds is demonstrated through the delegation of a senior manager, appointment of a full-time project coordinator and contribution of over R15 million. The investment in the recruitment and training of 40 community field workers is also an important component of the project. When the Care Project was initiated, its goal was to turn 70% of the retrenched people or nominated family members into economically active individuals within a two-year period, ending in December 2001².

The Care Project includes rural communities in Mozambique, Lesotho and Eastern Cape Province in South Africa, where most workers and retrenchees are resident.

The process enabling retrenched people or nominated family members to create their own jobs or find an alternative job is likely to be fraught with constraints such as dispersed markets or a complete lack of markets, infrastructure and cultural barriers.

Many large mining companies are providing financial help for social and economic community projects, but it remains to be seen whether many of these initiatives are sustainable, especially after closure. Government/industry partnerships for social development have started to develop since 1998 when Government developed a set of instruments and institutional mechanisms to deal with retrenchments in all economic sectors (Choshi, 2001). There are three phases of intervention:

² By 2003, they had managed to turn 60% of retrenched people into economically active individuals (compared to the goal of 70%). There has been a significant extension of the programme and it has been linked to South Deep's home-based care for terminally ill people (Von Weilligh, pers. comm., 2004).

- prevention of job losses,
 - management of job losses, and
 - regeneration of local economies,
- (Cooke & Limpitlaw, 2003).

Closure Costs

Closure costs are almost as site-specific as geology, but generalisations can be used to indicate the range of possible costs. On the low end of the spectrum, small mines in Romania cost around US\$1 million to close and rehabilitate. Closure costs for large lignite mines in Germany, on the other end of the scale, run to hundreds of millions of dollars (World Bank, 2002). Typical closure costs are in the tens of millions of dollars range.

The cost of closure tends to be lower where the owner/operator conducts the closure and clean-up process. Higher costs tend to be associated with state-run clean-up due to the lack of familiarity with the site (World Bank, 2002).

Early cost estimates are critical: accurate, timeous estimates are necessary to ensure that sufficient funds are available towards the end of the mine's life. The estimates should be updated systematically every five years (for a 30-year life of mine – every two years for a 10-year life) (World Bank, 2002). Progressive rehabilitation can save tens of millions of dollars in rehabilitation cost on closure.

The State of Closure Practice in South Africa

As part of a global review of good practice in mine closure, Cooke and Limpitlaw (2003) interviewed a range of stakeholders in the minerals sector to determine the current level of practice in South Africa. One of the key elements of good practice in current post mining site regeneration and closure that emerged from this exercise was the need for an holistic approach to closure planning. Such an approach should include the following elements:

- an assessment of the economic viability of the plan including the funding of post closure care and maintenance,
- inclusion of the closure plan as part of broader regional economic and development plan,
- relevance to the skills profile of area and local community buy-in to the plan,
- post-closure land use option(s) identified from the outset (pre-mining) with review during the operational phase of the mine, and
- an avoidance of a culture of dependency.

Community consultation is of critical importance. During consultation expectations should not be raised to unrealistic levels and any excessive community focus on compensation must be carefully managed³.

Biophysical aspects of closure that are emphasised in South Africa include:

- making the mine site safe,

³ The ICMM community tools project is useful in this regard (www.icmm.com).

- physical and chemical stability, and
- ensuring that there is no future pollution.

Potential risks relating to future water uses is a specific concern, especially when previously mined land is transferred to a new land owner(s).

Integrated Closure Planning at Rietspruit Mining Services (Hoadley *et al.*, 2003)

Rietspruit Mining Services, near Witbank, is an open cast colliery and is part of the coal business unit of BHP Billiton. Rietspruit Village was established to house the employees of the mine and their families. At peak production the mine employed approximately 1,500 people from the village, which was completely mine-dependent. Production ceased in 2002.

The main partners in the integrated mine closure plan are the Rietspruit community, the mine and consultants (Sustainable Villages Africa – SVA). SVA was contracted by the mine to execute and coordinate the socio-economic plans for closure. For many years the mine had been the provider – of food security, security of tenure, employment and a vision of a secure future. In spite of early advice to the community about closure, the community was despondent and disillusioned. This was expressed in the form of alcohol abuse, crime, vandalism and theft.

Through the closure plan, a number of “quick-win” projects were put in place. These were designed specifically to motivate and mobilize the community, to get their buy-in to medium-and long-term projects and to assist with the immediate problems of decreased spending power. Existing skills were exploited and, where required, higher-level skills were supplied by SVA.

Several start-up projects were initiated, including hydroponics tunnels for growing spinach, for local use and sale beyond the village, and meat processing to replace imports from outside the village. These projects, together with a plan to provide village maintenance services on behalf of the local authority, are designed for community self-sufficiency.

The projects have achieved their aim of generating community involvement. Although designed as quick-return projects, they will all become long-term sustainable initiatives and will provide much of the skills and experience needed for the bigger projects envisaged by the Community Forum. Profits from projects will be put in a fund for further job creation and project development.

Rietspruit Mine Services will remain functional until closure and rehabilitation is complete. This is expected to be within two to three years. The mine’s initial social plan was visionary – it was one of the first to provide family housing units for workers – and its retrenchment strategy was forward looking. The advantage of this progressive attitude was that the community was not left in dire poverty, has a high literacy rate and a substantial skills base. The mine is an active partner in the socio-economic transition of the community, and is undertaking the rehabilitation of the land which is planned for use as prime pasturage by 2008.

Trade Offs

To initiate a process of integrated mine closure planning, trade-offs are required. The main set of trade-offs occurs between stakeholders. One respondent in the survey conducted by Cooke and Limpitlaw (2003) stated: “...*trade offs are predominantly between the need for the most sustainable end-state and the cost implications of perpetual care of maintenance. At some stage the mine has to be able to finally walk away and at that time, the community and government have to be satisfied that no detrimental impacts remain*”. Other respondents recognised trade-offs:

- between viable economic growth and the need to pull as many members of the community out of poverty,
- between the post-mining land use and the sound economic basis for the region, and

- between communities and the mine in both accepting their responsibilities and obligations especially post mine closure.

Decisions should be reached through multi-stakeholder consultation, including government, industry, labour and the communities. Legislation can be used as the final arbiter of any decisions – companies should make the decisions but should use legislation to guide their (transparent) decisions in the face of demands by other stakeholders. Companies must work within their licence to operate but not leave themselves open to liabilities.

Constraints in decision making include: financial limitations, community expectations, and a lack of information and time. Minority rights should be able to influence decision-making – due consideration of these rights is important, but not limiting. Similarly, majority rule in closure planning decisions is not essential. A successful closure planning process should lead to an agreement with government as the final arbiter.

Drivers of Change in Closure Practice

In South Africa, the two main drivers of change in closure practice are industry and government (Cooke & Limpitlaw, 2003). Labour movements may play a pivotal role in some instances, such in the case of the Grootvlei Gold Mine (see text box), and they drive negotiation of trade offs. Communities may also strongly influence closure, but in general, industry and government drive the negotiations.

After heavy rains in 1996, one of the last operating mines in the East Rand Basin of the Witwatersrand, Grootvlei Gold Mine, began discharging large volumes of polluted mine water. Iron oxide sludge was depositing in a wetland downstream and the Department of Water Affairs and Forestry (DWAF) was alerted to the situation after receiving complaints from farmers. In terms of the mine's discharge permit, the operation could have been closed by the Minister of Water Affairs and Forestry. Intervention by the National Union of Mine Workers to protect 6,000 jobs prevented this and the mine was given three months to rectify the problem. Consequently, a liming plant was constructed. In the interests of preserving jobs, the Government started contributing one million Rand monthly towards the mine's cost of pumping water from the workings (out of a total monthly cost of R 2.5 million) (Viljoen, pers. comm., 2003).

An important question in the closure trade-off debate is the contribution to be made by communities and the reciprocal responsibilities of companies. The complexity of this issue is increased by the degree to which Government affects this negotiation.

The trade-offs around environment and development are also complicated by a lack of Government/company consensus on priorities. In one instance, a mining company had intended for restore mine land for ecotourism use, only to find out that the Department of Trade and Industry intended to establish a manufacturing node in the area (Cooke & Limpitlaw, 2003). There is also no guarantee that development objectives set by Government today will still be in place after a thirty-year life of mine.

South African development priorities are currently focused on addressing critical backlogs. These include the creation of wealth, black economic empowerment, bridging the historical wealth divide and providing access to land. Acute under-development may result in pressure to continue mining even when the environmental impacts outweigh economic benefits. The former BHP-Billiton mine, Ok Tedi in Papua New Guinea, is arguably an example of this.

Where to Next?

There is a need for the best quality information (based on scientific studies and objective analysis) to be available to decision makers (Cooke & Limpitlaw, 2003).

To take closure practice forward work needs to be done on:

- how to finance closure,
- how to address the social issues,
- developing a body of good and bad practice case studies, and
- developing a closure scorecard.

It is essential to consider the larger regional scale with regard to mine closure planning and for mines not to be closed in isolation. There is a need for case studies and the development of processes for this regional approach (Cooke & Limpitlaw, 2003).

The main criteria for closure for sustainable development include:

- Maximising economic gain over the life of mine and, either, create a self-sustaining (human) community with social and cultural integrity or, remove and resettle the mine dependant community. Leave something behind that has value.
- Informing and educating the community to ensure that the issues concerning the three spheres of sustainable development related to mine closure are understood.
- Identification of a viable end land-use before mining, excellent rehabilitation of the ecosystem for a specific land use together with restoring the land's ecological integrity and potential. Environmental impacts should tend to zero over time.
- There is a necessity for sound management after closure. Government is seen as playing an important role by providing extension services. This goes with developing alternative skills for the workforce and the provision of a diversified economic base long before closure. There must be dedicated enforcement of plans by regulators both during mining and in the closure and post-closure phases.
- Reasonable access to alternative minerals on the same property (where this is possible).

(Cooke & Limpitlaw, 2003).

Principles on which successful closure is premised include the following:

- Transparent and full consultation between all stakeholders during the closure planning and implementation processes.
- Closure planning and implementation are part of an integrated mine plan and are considered as critical variables when any decisions affecting mining operations are taken.
- Every mining project must consider the contribution required to create a sustainable community and environment on closure.
- Minimisation of dependency on the mine during life of mine so that alternative economies are promoted before closure.
- Environmental and social costs of mining operations must be internalised during the operational life of the mine to avoid high cost mining legacies on closure.

(Cooke & Limpitlaw, 2003).

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