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Mine relinquishment – processes and learnings

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Abstract

Mine relinquishment in general terms is the completion of the reclamation activities, meeting agreed closure objectives and return of the site to the landowner. Relinquishment planning and completion is a concept that governments and communities speak to as an expectation and that the mining industry aims to achieve. But there are very few standards or guidelines that provide the how to, and only a precious few mine sites have attained all or even partial release. As regulatory requirements for mine reclamation activities and reporting evolve in detail and scope, and bonding becomes the norm, reaching the end point remains elusive for many sites. Instead the current end point for most is care and maintenance. Is relinquishment possible, or practicable, or is it becoming less probable? This paper looks at the issues that affect the likelihood of relinquishment. Case studies are discussed, with learnings that help lead the way, and those that highlight the road blocks. Many mine operators have the best intentions in protecting the environment, and returning reclaimed mine sites to the land owner in a safe and sustainable condition for future post-mining use. It makes good business sense for the future of mining. It is time to move the conversation beyond reclamation planning and forward to the possibility of relinquishing mine sites through a process that ensures sustainability of mining and the confidence of the land owner.

1 Introduction

Standard operating licensing for mine projects requires a closure plan and in most countries, a form of financial assurance as a guarantee that if a site is not closed to an agreed level of environmental stability, sufficient financial assurance is available to government to carry out suitable further reclamation and closure works. Generally, the secured amount corresponds to the size of facilities, and is calculated on the total liability that will occur as part of the mine project. The total liability covers third party costs to conduct reclamation work, administration, monitoring and contingencies (INAC, 2002).

Mining companies are expected to periodically update closure plans through the life of the project, culminating in a final closure plan prior to cessation of the operations. These plans for the most part describe the land use at closure, supported by closure objectives as guides for individual, component or elemental-specific end points. Closure performance criteria are a common mechanism for measuring success in meeting the objectives although their classification and degree of complexity is site specific.

While the processes of mine closure planning and financial assurance are now fairly well defined, an aspect of closure that is not so well understood is relinquishment, where the agreed post-closure land use has been achieved to the satisfaction of all relevant regulators and stakeholders. At this stage all bonds are retired, conditions deleted from licences, the mining tenements are surrendered, and the original landowner accepts future liability for the land. Most mining operations aspire to closure planning with the ultimate objective of relinquishment of the site. The ideal outcome for mine closure is a walk-away scenario, where all hazards and liabilities have been resolved and the land has been returned to a beneficial use.

With this in mind, mine closure plans are commonly formulated on the premise that once mining ceases, the implementation of mine closure will be relatively straightforward, with relinquishment occurring soon after the final closure works have been completed. However, Bocking (2010) notes that there is a growing inventory of mines that have been unable to achieve final closure to agreed post-closure land uses.

One of the reasons for this is that in the majority of the closure plans reviewed by the authors, the post-closure monitoring phase leading up to relinquishment is estimated between five and ten years. While this may be achievable for a site with simple reclamation requirements, and few and very low post-closure risk

issues, it is overly optimistic for any site that needs to demonstrate more complex land use performance criteria.

Nevertheless, reclamation works that do not fully achieve the agreed performance criteria will still significantly reduce the potential for detrimental impacts compared to mines where no reclamation has been undertaken. Even with the best possible reclamation programs, there is likely to be some reduction in the productivity and environmental value of many mined areas. This can be addressed through compensation agreements between mine operators and landowners or land custodians (Queensland Government, 2004), or through an environmental/social offset where the lost land value is replaced by upgrading an equivalent area more useful to the post-closure land users. The latter is more likely to succeed in terms of reclamation criteria, resulting in a win-win for all parties.

Where remediation or reclamation cannot be completed successfully the company still has a number of options to deal with the property:

1. Retain the property – with internal funds for future maintenance costs and risks.
2. Return the property to government – with payment to cover future costs and residual risks. A trust fund or other financial arrangement that will generate income for ongoing management of reclaimed areas could provide a means for early sign-off and hand over to government.
3. Transfer of ownership to special purpose company and purchasing insurance against residual liabilities on the property.
4. Transfer some of the assets to a local community or government with some arrangement to cover costs of future maintenance and risks. (Bocking et al., 2009).

In all cases, the ultimate goal remains the minimisation of the risk of harm to the environment and the community in the long term.

2 Reasons why mine sites remain in care and maintenance

The national (Canadian and Australian) proportion of mines that have been successfully relinquished compared to those that remain under full or partial care and maintenance is not formally tracked by governments, Non Governmental Organisations, or industry. This is mostly the result of the complications in defining what a mine site is, variations in level of detail and completeness from jurisdiction to jurisdiction, and the absence of standardised procedures for measuring mine closure. A precursory review of Canadian and Australian mining records by the authors confirms however that the ratio of relinquished to perpetual maintenance sites is weighted heavily toward ongoing care and maintenance. Reasons why the end point remains elusive are numerous. Prior to the 1980s full closure was not required, nor encouraged, and the legacies of those abandoned sites and associated liabilities are obvious today. But even today very few operations are fully or partially reclaimed and relinquished, even though societal and environmental expectations favour the removal of liabilities and the return of disturbed sites to productive land use. The following sections discuss the major roadblocks to successful mine relinquishment.

2.1 Inability to demonstrate performance

The leading reason centres around the inability to demonstrate the achievement of performance criteria, to a level that convinces regulators and other stakeholders that the predicted residual liabilities represent low, manageable and hence acceptable risks. Uncertainty is inherent in mine closure, and is typically reflected in issues such as acid mine drainage from waste storage areas, performance of engineered covers, the role of permafrost in northern regions, or drought in central areas, and more recently the complicating effects of global warming. These issues may not become apparent for many years. Poor experience with the success of closure plans, as well as the recognition that many defects are not apparent (or not recognised) at the time of custodial transfer has resulted in reluctance by succeeding custodians to accept transfer of mined lands (Robertson and Shaw, 2010).

2.2 Absence of regulatory procedures

Although there is a legislative expectation that progressive reclamation will be done and financial incentive built into the discounted financial assurance system, the rate at which progressive reclamation is occurring is impeded by the lack of relinquishment procedures across many jurisdictions. A company that spends many millions of dollars on progressive reclamation (while still having an equal amount bonded to regulators) has no certainty that this action will result in release certification when the mining lease is surrendered (Queensland Government, 2004).

2.3 Inconsistent expectations

There is often a significant disparity between the security based on estimated reclamation and closure costs, and the regulator's view of the potential future liability to the taxpayer. The uncertainty associated with the long term liability associated with mine closure is generally an area for dispute between the regulator and the mining company. In most cases risk quantification over long periods of time is unreliable, there is a lack of precedent data that can be used to verify predictive modelling, and the quantification of potential long term liabilities, or securities reductions as liabilities are reduced, is complex. To address this uncertainty regulators require a guarantee and/or a contingency allowance over and above the mining company's estimated reclamation costs, which already carry a hefty contingency. The use of stochastic modelling, using variance in likelihoods has been one approach used to achieve a more robust costing of residual risks. This provides a more detailed estimate that highlights the key reclamation risk cost drivers through sensitivity analysis.

2.4 Uncertainty in closure objectives and performance criteria

A mine closure plan at the environmental assessment stage is predicated by the life of mine plan, and legislation in place at the time of permitting. Life of mine plans, legislation, social expectations and markets change and evolve, particularly over long mine life projects. In such cases where closure planning is not integrated with life of mine planning, and hence does not update the closure plan and cost estimate to align with the latest thinking, the closed mine is unlikely to meet stakeholders expectations, and hence the mining companies are unlikely to achieve relinquishment without additional closure works.

3 Case studies

While mine closure references cite numerous examples of reclaimed mines, there are few examples where complete relinquishment has been achieved. Examples of successful mine relinquishments generally pre-date current reclamation policies and regulations, with the expectations for liability release being very different today compared to 10 to 20 years ago. When selecting case studies for this paper the authors have focused on aspects that illustrate what success in relinquishment would mean. The examples below are studies where the bulk of the reclamation activities have been completed, some form of reduction in liability and financial assurance has occurred, and there is positive progress towards final release. The case studies provided are examples that will hopefully inspire future improvements and successful relinquishment.

3.1 Polaris Mine

Polaris Mine is operated by Teck Resources Ltd., and is located in Canada's Arctic, Nunavut. It is the world's most northerly based metal mine. The underground zinc and lead mine operated from 1981 to 2002, and the Final Closure Plan was approved in 2002.

The decommissioning and reclamation activities at the Polaris Mine site have been presented at a number of international conferences as one of Canada's successful mine reclamation projects. This is due in part to meeting the logistical challenge and cost of the reclamation project in a remote northern location; with the ultimate goal of a 'walk away'.

Equipment and non-perishable supplies for reclamation were brought to site in ice rated ships from Montreal during the short ice free period in summer. Any supplies that could not be brought in by ship had to be flown in from southern Canada. Infrequent commercial air service and foggy weather conditions complicated the movement of personnel and materials. Excavation of frozen ground was difficult, slow and expensive.

However, disposal of building debris, and metals and hydrocarbon contaminated soils by encapsulating them in permafrost was used as a secure long-term disposal method. Global warming was also anticipated in the design of the landfills covers.

Reclamation of the site involved the removal of all buildings, demolition materials landfilled and hydrocarbon contaminated materials placed in the exhausted underground mine. The site has been monitored for seven years, and monitoring indicates the physical landscape is stable, water chemistry is stable, and permafrost freeze-back in the landfills is progressing well. These indicators gave confidence to the Nunavut Water Board to reduce the reclamation security in 2009. In 2011 both the water licence and the land leases for the site expire, and currently the company and regulators are discussing whether or not to extend them (Donald, 2010).

The closure of the mine site is also seen as a success because of the ability to reduce liabilities to the satisfaction of the regulator, and hence to receive reduction of securities.

3.2 Bottle Creek Mine

Bottle Creek Mine is located in Western Australia and began operations in June 1988, but due to limited gold resource ceased operations in November 1999. Three open pits and waste landforms, a plant site, run of mine pad and two tailings storage facilities were established during operations.

In May 1990 a proposal to reclaim the site was submitted by Norgold Ltd to the then Western Australia (WA) Department of Minerals and Energy (DME). In 1992 the Minister for Mines approved a refined plan and required unconditional performance bonds to be lodged. The mine was largely reclaimed by 1994 but, soon after this, 300 mm of cyclonic rainfall resulted in significant erosion and gullying on the landforms. DME requested that Norgold undertake appropriate rehabilitation works to repair the damage caused by the cyclonic event.

In September 1996, Norgold requested that DME release the bonds. The environmental inspector raised a number of issues that required attention prior to bonds being retired. These issues included remediation of erosion gullies, reseeding poorly vegetated areas, battering-down of slope angles (on some of the remaining structures), application of topsoil to several areas, and backfilling of drillholes. Two more joint site inspections were undertaken in October 1996 and in June 1997 Norgold was requested to submit a new reclamation plan to detail how, when and to what standard it would undertake the remediation works required by the DME.

In November 1997, Norgold submitted a new reclamation plan. The work was completed by May 1998. DME undertook another site inspection in May 1998 and identified further small works. In November 1998, Norgold submitted a compliance review as well as a monitoring program report which included a validation of the reclamation and developing ecosystem using ecosystem function analysis. A closure inspection was undertaken in December 2000 which identified two issues that had not been resolved to the satisfaction of the DME; the potential for acid rock drainage and the presence of feral goats within the fenced area. Rio Tinto (which acquired Norgold) investigated and subsequently addressed these issues to the satisfaction of the DME which recommended that the bonds be returned and that all tenement conditions relating to the project be deleted from the schedule of conditions attached to each tenement. In November 2001, the Minister for Mines deleted all tenement conditions and returned the bonds, confirming that Norgold had reclaimed the site to the satisfaction of the state mining engineer (DITR, 2006).

The Bottle Creek Mine is a case study where persistence in closure activities, consultation and meeting final requirements eventually worked for Norgold and subsequent owner Rio Tinto. The use of a robust monitoring technique over time was able to adequately demonstrate achievement of the reclamation completion criteria. This evidence was accepted by the regulator leading to final relinquishment. The regulator continues to monitor Bottle Creek Mine by conducting occasional monitoring programs at fixed transects at the site.

3.3 Beenup Mine

The Beenup mine site is located in the South-West of Western Australia, near the confluence of the Blackwood and Scott Rivers, on the Scott Coastal Plain. Land use within the Scott Coastal Plain area

primarily consists of pasture production for beef and dairy, silviculture and some horticulture. Mining operations for minerals sands at Beenup commenced in January 1997 and closed in February 1999 leaving a large expanse of deep water, a number of temporary and permanent dams and stockpiles containing mine waste consisting of cleaned sand, fine clay and varying levels of pyritic mineral. At the time of closure, a total area of 336 hectares of land had been disturbed. The majority of the disturbance was associated with the dredge pond and above ground storage facilities.

In preparing the Beenup reclamation plan BHP Billiton adopted a closure philosophy that fostered continuous improvement, and engaged a community consultative group that was actively involved at the time of the mine closure. The Beenup Consultative Group (BCG) included Shire representatives, landowners, and business and conservation group representatives. BHP Billiton prepared visual impressions of the various reclamation concepts that assisted in the selection of the of the preferred reclamation option. The BGC played a significant role in the selection of the preferred closure concept which included backfilling the dredge pond with mined material, creating wetlands surrounded by native vegetation and pasture. Acceptance of the preferred option by Government and the BCG provided direction for the development of the detailed reclamation plan.

The BCG also assisted in identifying key issues to be dealt with in the implementation process and provided a communication channel for Government to obtain feedback on aspects of the plan. In 2001 the BCG set up an independent audit of the progress of the closure works against the reclamation plan based on a protocol which they developed. This process facilitated continuous improvement and enabled the local community and company the opportunity to ensure ongoing implementation of the latest advances in reclamation technology, so that the end result would be acceptable to future generations.

Since completion of the earthworks and revegetation activities, both Government and community maintain confidence and ownership in the progress of the reclamation project and the community are well familiar with and speak with some authority on the principles and progress towards sustainability.

The closed Beenup site is currently in monitoring and care and maintenance with a positive outlook to achieving relinquishment at some time in the future.

Beenup mine is a case study where the proponent identified early in the project that the mine closure should create a landform that is productive and sustainable for generations to come, designed and implemented in consultation with the local community.

Key to the success to date of the Beenup closure project was:

- Early stakeholder involvement, once the decision to close the mine was announced, through the community consultative group engaged during operations.
- Continuity of the owner's team and the members of the community consultative group.
- Transparent disclosure and understanding between the company and community with in-depth investigation and review of alternative strategies and methodologies to alleviate stakeholder concerns.
- Facilitation of an independent audit of the reclamation works and post closure monitoring and care and maintenance.
- Robust technical designs that achieved the closure performance criteria (DITR, 2006).

3.4 Contact Lake gold mine

The Contact Lake gold mine first began commercial production in January of 1995 under the operational management of Cameco Corporation. After three and half years of production the mine closed in June 1998 due to ore depletion. Reclamation of the site was completed between 1998 and 2008. Reclamation activities included removal of site operations buildings and mill, backfilling two of the crown pillars, placement of engineered caps over surface openings, and covering of tailings under a permanent water cover in Turtle Lake.

In developing the decommissioning plan for the Contact Lake site, Cameco Corporation operated under the principle that undue burdens to manage the site should not be placed on future generations. This principle led to the conclusion that a passive approach to designing the site for closure was preferable to a design that would be more cost effective, but would require more significant ongoing institutional control monitoring and maintenance. As a result Cameco virtually eliminated the need for maintenance on site in the long term and therefore any potential costs that may have been assumed by future generations (SRK, 2008).

In 2009 Cameco submitted applications for Release from Decommissioning and Reclamation from the Saskatchewan Ministry of Environment, and for custodial transfer of the property as defined by the Province of Saskatchewan's Reclaimed Industrial Site Act. In that same year the mine had the distinction of being the first decommissioned and reclaimed mine site to be entered in the Saskatchewan Government's Institutional Control Registry.

The Institutional Control Program (ICP) was initiated by the Saskatchewan Government in 2005 for the long term management of decommissioned mine and mill sites on provincial Crown land. The Saskatchewan Government recognised that a formal regulatory process was required for the long term monitoring and management of provincial lands when mining/milling activities are complete, and that once the required decommissioning and reclamation have been completed and received approval, responsibility for a site on Crown land would revert to the provincial Crown.

Institutional Control consists of those actions, mechanisms and arrangements implemented in order to maintain control or knowledge of a remediated site after project closure and custodial transfer to some form of responsible authority. The two primary components of the ICP are the Institutional Control Registry and the Institutional Control Funds: the Monitoring and Maintenance Fund and the Unforeseen Events Fund. The Registry maintains formal records of closed sites, manages the funding and performs any required monitoring and maintenance work. Registry records include the location and former operator, site description and historical records of activities, site maintenance, monitoring and inspection documentation and future allowable land use for the site. The Monitoring and Maintenance Fund pays for long term monitoring and maintenance; the Unforeseen Events Fund will pay for unforeseen future events. Examples of these may include damage resulting from floods, tornadoes or earthquakes. To address the province's risk of accepting sites into custodial responsibility and the costs of future monitoring and maintenance and unforeseen future events, dedicated site specific funding is established by the site holder responsible for an individual site. The funds would be managed by the province but are legislated and independent from the provincial revenue (Saskatchewan Ministry of Energy and Resources, 2009).

The Contact Lake mine closure is a case study that highlights where successful reclamation and relinquishment has occurred. The mine operator has fulfilled the expectations of local stakeholders in reclaiming to a sustainable land use, and the responsible regulatory agency has provided a clear process for custodial transfer, as well as provision for management of any remaining liabilities.

4 Lessons learned from case studies and closure research

The preceding case studies highlight some of the steps required to succeed in obtaining reductions in liabilities and financial assurance. The following is a brief discussion of the key lessons learned from review of government and technical documents, papers and reports:

1. Proponents should engage and discuss reclamation plans and final land use objectives with stakeholders during project conception, throughout the mining operation, and in preparing for closure. Societal expectations and government regulations will change over the long operational period of some mines. Anticipating impacts and working through resolutions with stakeholders will allow the mining company to gain the confidence of the succeeding custodian (DITR, 2006; Robertson and Shaw, 2010).
2. Early establishment of practical, achievable and verifiable completion criteria is critical to receiving acceptance and approval for relinquishment by the regulator. Start with simple criteria and fine tune through trial, testing and monitoring. A robust and verifiable process to monitor and demonstrate completion criteria is crucial for successful closure (DITR, 2006).

3. Closure plans must clearly differentiate those areas of the mine that are likely to remain under care and maintenance (and how they will be managed), and those areas that will be fully reclaimed. Early categorisation of post-closure land uses establishes whether the mine area will be released through close-out of individual leases or permits, and/or by mine components as they are reclaimed. It assists in identifying where reclamation efforts should be focused, how the financial assurance will be managed as it is reduced, and how any long term issues will be managed.
4. Progressive reclamation provides a real opportunity for demonstrating closure technology, and for identifying 'hidden defects', and correcting them prior to final closure. Progressive custodial transfer provides a 'test' of the succeeding custodian's willingness to accept custodial responsibility and risk (Robertson and Shaw, 2010). Front end loading and demonstrated results supported by monitoring of performance criteria are key to demonstrating that risks are manageable and acceptable.
5. Mining companies should not expect financial assurance reduction immediately following reclamation activities, but should agree with the regulator on an appropriate term of monitoring to confirm closure objective and performance success (DMP, 2009). An application for relinquishment must be supported by adequate monitoring data used for predictive modelling of long term performance indicators, where possible subjected to expert third party review. Ultimately, it is the proponent's responsibility to prove physical, chemical and biological stability to the regulator.
6. Multiple regulators can sometimes result in overlapping liability and bonding responsibilities, and confusion regarding environmental approvals, inspections and reporting. This can be further complicated where aboriginal land owners also need to be consulted as stakeholders. The identification of a single agency responsible for environmental approvals and inspection establishes a clear path for communication between the proponent and the regulator. Final relinquishment sign-off is held with a senior regulatory authority.
7. An inventory/data-base of orphaned, abandoned, relinquished, and sites in care and maintenance would assist in removing barriers to clean-up and remediation, introduce standardisation, provide single-window access to information, facilitate adding more detailed information in the future, and document lessons learned. For example, the number of orphaned and abandoned mines in Canada and their physical, health and environmental impacts and liabilities are not well documented (NOAMI, 2009). An inventory of sites would be an important step toward creation of best practices and fostering of successful mine closure.

5 Components of a relinquishment plan

No single authoritative reference was found that could provide a comprehensive relinquishment process or the components of a relinquishment plan. The following key components of a relinquishment plan have been compiled from a review of regulatory reports and closure guidance documents as a guide, recognising that variations will occur where formalised procedures are in place:

- Identification of the appropriate regulatory agencies and responsibilities, as well as licensing and permits applicable to the mine site closure plan.
- Summary of financial assurance, including the form/s of insurance and allocation to various licenses and permits.
- Identification of applicable stakeholders and process for stakeholder engagement.
- Agreed closure objectives and performance criteria. Where appropriate, the predictive modelling process should also be agreed.
- An agreed performance monitoring plan (self-assessment procedure) including monitoring parameters, locations, and schedule.
- Progressive reclamation plan and agreed progressive custodial transfer and liability/bond reduction process.
- A process for dealing with areas that fail to meet performance criteria, including adaptive management and corrective action.

- Schedule for periodic review of predicted risks, and unforeseen risks, including adjustments as new liabilities arise, and/or reduction as reclamation proceeds.
- A process for independent peer review of the closure performance supported by monitoring data, photographs, technical reports, design drawings and as-builts etc.
- An agreed close-out procedure for applicable regulatory agencies (i.e. release certification, transfer of assets and liabilities, indemnification).
- Record of performance for closed areas of the mine site, and sites under reclamation.
- Record keeping procedure and location, while under care and maintenance, during close-out of sites, and following transfer to custodian.
- Liability reduction schedule as reclamation work is completed.
- Periodic update of the cost estimate.

6 Conclusions

Relinquishment of a closed mine site is complicated by the subtle disparity in the expectations of the mining operation and the succeeding owner. The mining operation works toward reducing post-closure risks so they are small and manageable, but the new owner cannot accept risks unless there is substantive proof that the long term post-closure predictions are valid, and that the post-closure risk is acceptable and manageable – practically and financially.

In the absence of formal relinquishment processes, the early consideration and planning for the management of relinquishment risks will benefit both parties enormously. Progressive reclamation also provides a real opportunity for confirming the technical success of reclamation designs, and hence for confirming the validity of risk tolerance and acceptability. The earlier progressive reclamation is implemented, the more trust between the two parties, and the earlier the commencement of progressive liability and bond reduction and custodial transfer, whether during the life of the operation, or after final closure.

Mining companies would probably spend more time and money on progressive reclamation if a formal process for certifying progressive reclamation existed, or if such a process were agreed at the time of bonding. Without a formalised procedure there is little incentive for mining operators to carry out progressive reclamation, since there is a benefit in deferring the expenditure and using the funds elsewhere. Unfortunately this drives the wrong behaviours as neither party benefits from the lack of knowledge, data, information and trust that would be provided by the progressive reclamation.

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