

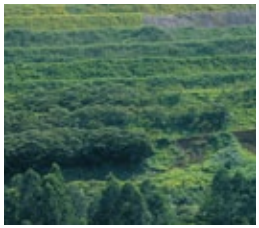


GUIDE FOR MINE CLOSURE PLANNING

IBRAM
INSTITUTO BRASILEIRO DE MINERAÇÃO
Brazilian Mining Association
Câmara Minera de Brasil







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FOREWORD

To help enhance knowledge on Mine Closure, the Brazilian Mining Association (IBRAM) is now publishing its "Guide for Mine Closure Planning". This report includes a set of guidelines and best practices on the cessation of a mining operation.

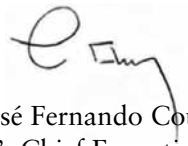
The topic has been widely discussed by society. Its impact goes well beyond industry-specific laws, which focus on the physical aspects of mineral depletion. This concept covers socio-economic and environmental issues, and presents a view of post-mining legacy.

Currently, all stakeholders must be involved in mine closure planning – company, government, communities – when defining the scope of the task. This integration in the planning process is key to ensure that the mining project will generate lasting value, even once the mining company has left.

The Guide contains a number of recommendations in the form of guidance. This is not a manual to be referred to for pre-defined answers, but as a set of guidelines whose implementation requires professional interpretation and a case-by-case approach that is tailored to the corporate culture of a company. Therefore, it provides a view that is closer to the mining environment in Brazil, with scenarios and hands-on case studies focusing on the unique features of Brazil.

Over the coming decades, a number of mines will come to the end of their lives. The way these closures are planned and managed will be a beacon for the mining sector. This could affect both the costs related to the closure stage and the benefits generated to society, probably bringing about new governance arrangements for the industry.

In view of this, IBRAM prepared this guide with a view to strengthening the capacity of governments, private sector and communities to manage the mine closure stage in the mining business in order to contribute to long-term sustainable development inareas where mining takes place.



José Fernando Coura
IBRAM's Chief Executive Officer

EXECUTIVE SUMMARY

Planning for the closure of a mine, whether it involves a new project still in the design stage or a mine already in operation, is an important item in the agenda of mining companies, regulatory bodies and the academic community, as well as the affected communities. Issues pertaining to closure of a mine are directly related to the sustainability of a business that is vital to contemporary society.

In spite of its evident importance, there is no consistent approach to mine closure planning. This Guide has been prepared with the intention of raising awareness of the strategic nature of closure planning among senior corporate managers; introducing best practices that reflect current knowledge of the subject; and informing and guiding both mining professionals and other stakeholders on the main issues related to mine closure planning.

When operating and closing a mine in accordance with best practices, a company shows the ability to respond adequately to environmental protection and social responsibility requirements, thus contributing to sustainability. Obtaining governmental clearances and licenses, acess to financing and a social license to operate is made easier when a company considers such best practices and shows tangible results.

Closure is meant in this Guide as the point in time which marks the end of decommissioning activities in a mine. **Decommissioning** is the phase that usually begins shortly before the end of mining production (**cessation**) and concludes once all unnecessary facilities and infra-structure have been removed and steps have been taken to ensure the area is safe and stable, including reclamation and social programs. The **post-closure** phase takes place after full

implementation of decommissioning actions, and includes actions such as care, maintenance and social programs towards achieving **closure objectives**. (See the Glossary for an explanation of these and other terms.)

Closure of a mine is said to be scheduled or as planned when the cessation of mining operations follows the Closure Plan. When cessation takes place ahead of the schedule, this is called **early closure**, which is usually preceded by a stage of **care and maintenance**, which may result either in resumption of production or in early closure.

Two post-closure scenarios are considered: permanent and temporary care. The former calls for the presence of the company to implement actions required to achieve closure objectives, and these could last for several years. Under the temporary care scenario, the necessary actions are limited to tasks such as inspections, monitoring and other actions that usually require one-off measures.

The closure process is completed once responsibility for surveillance of the area is assigned to a third party, usually after compliance with legal obligations and predefined **completion criteria**.

This Guide is divided in two parts: (1) Chapters 2-7 discuss the fundamentals and some basic concepts for planning the closure of the mine, including the relevant terminology; (2) Chapter 8 provides a set of seven guidelines and 37 best practices for planning closure. A description is provided for each best practice, along with additional sources of information. Wherever possible, real examples of situations related to mine closure in Brazil that could serve as a reference, inspiration or simply as a record of best practice are provided. Seventeen cases are featured as examples of good practice. Appendices provide recommendations to assist in the implementation of some practices. A glossary provides definitions for selected terms that appear throughout the Guide and that may be unfamiliar to some readers.

Drafting of this Guide involved mining companies and various stakeholders. Two workshops, interviews and a round of public consultation were held prior to preparation of a draft version that went through a round of comments. A second draft of the Guide that included a wealth of comments was made public by IBRAM. New feedback was received and used in this final version of the Guide.

Partly as a result of this consultation process, the Guide has a managerial approach, i.e., the management of mine closure planning is presented as a strategic action for mining companies. This also results in a key feature: this is a Guide for planning mine closure, not to prepare a closure plan. The reader is referred to relevant local or national regulations when writing mine closure plans.

The closure plan is a document that reflects the outcomes of planning by setting closure objectives and describing the actions to be taken to achieve them so as to guide the mining company and other stakeholders involved - consultants, designers, government officials, financial analysts, local governments, and civil society organizations for whom this Guide is meant.

The Guidelines described in the Guide are:

1. **Closure planning should start as early as the design stage for a new mining project**

   This is the basic approach used in international guidance. Closure planning is part of the feasibility study for a mine, so that the options for post-mining land use are considered at the same time as project development options. Terms such as "designing for closure" or even "designing for post-closure" have been used to describe the adoption of this guideline by the teams involved in feasibility studies and development of mining projects. Full implementation of this guideline is justified by the fact that mining is a temporary use of land, which will give way to new uses once mining ceases.

2. Mining companies should plan for the closure of mines in operation

For mines in operation, there is no opportunity to benefit from planned closure since its design, but many practices under Guideline 1 still apply. A constraint for planning is given in advance: all interventions already undertaken, and the entire history of relationship with stakeholders including those of trust or distrust that were established and renewed with them. Furthermore, managers and planners of mines already in operation may have only a partial and incomplete understanding of the bio-physical and socio-economic environment where they work. Even knowledge of certain important features of the mine itself that is needed to plan for closure may be insufficient. For such reasons, for mines in operation, setting closure objectives should be preceded by the preparation of a robust database on the project, its history and its social and environmental setting.

3. Closure planning should engage both external and internal stakeholders

The strategies and efforts that should be deployed in this process vary according to the nature, location and size of the project, as well as the stages of its life cycle. An effective process of stakeholder engagement enhances relationships with the directly affected community, as well as other social groups. These relationships can significantly help improve mine closure planning, including objective setting. Engaging internal and external parties involves their identification and analysis, disclosure of information on the project, consultation with stakeholders, negotiation and establishment of partnerships, conflict management, involvement in monitoring, and accountability reporting.

4. The results of planning should be captured in closure plans and other related documents

The Closure Plan is a document that consolidates and summarizes the strategy and vision of a company on the closure of a mine. It also provides a sufficiently detailed description of the actions or programs to be implemented in order to achieve the closure objectives. A misconception prevails that the purpose of closure planning is to develop a document (Closure Plan). This plan is simply a means, not an end. Recording relevant information on closure makes it possible to take advantage of and reuse the experience from past projects in order to avoid repeating mistakes, improve information sharing across the company, and enhance individual and organizational learning. In addition, keeping records avoids loss of intellectual capital should the individual in charge of closure planning leave the company or change positions.

5. The company should estimate all costs associated with the closure of a mine

Developing an accurate estimate of closure costs involves several challenges. One such challenge is the fact that most expenses related to closure are not incurred until the production cycle ends. This has two implications. First, expenses will be incurred after the revenue stream has ended. For companies that operate multiple mines, this is not a major challenge since the expenses can be covered by revenue from other mines, but if the company decides to sell off the mine, the security provided by the remaining assets ceases to exist. For this reason, many countries require that a collateral fund established for each mine which is sufficient to cover all expenses related to closure programs, including those required for the post-closure stage. It is important to make a clear distinction between a collateral and a financial provision. The former is provided in favor of third parties, whereas the latter is

an internal accounting tool. In either case (collateral or financial provision) an estimate of the cost for implementing closure actions is required.

6. Mining company should monitor socio-economic development

Establishment of a new mining project can help bring about a cycle of economic growth in the municipalities where it is located, and it can help raise levels of *per capita* income, with positive effects extending to a wider area. One cannot expect, however, that the growth rates in a given moment of deployment and operation of a project will last for decades. To make sure a positive legacy exists, in addition to fostering economic growth, a mining company should be able to contribute to sustainable development, such that the community can continue to develop once the mining operation comes to an end. The mining company can play a pivotal role in community development by pursuing initiatives that promote conversion of a local asset – the nonrenewable natural resource – into a another local asset of a different nature, i.e., human and social capital. To this end, the strategic long-term corporate goals should be aligned with current and future development plans of the community and the region. The company should engage stakeholders and pursue initiatives aimed at strengthening the capacity of the local community. Ideally, these principles should be in place from the early stages of a project, and they should be carefully considered during the decommissioning stage.

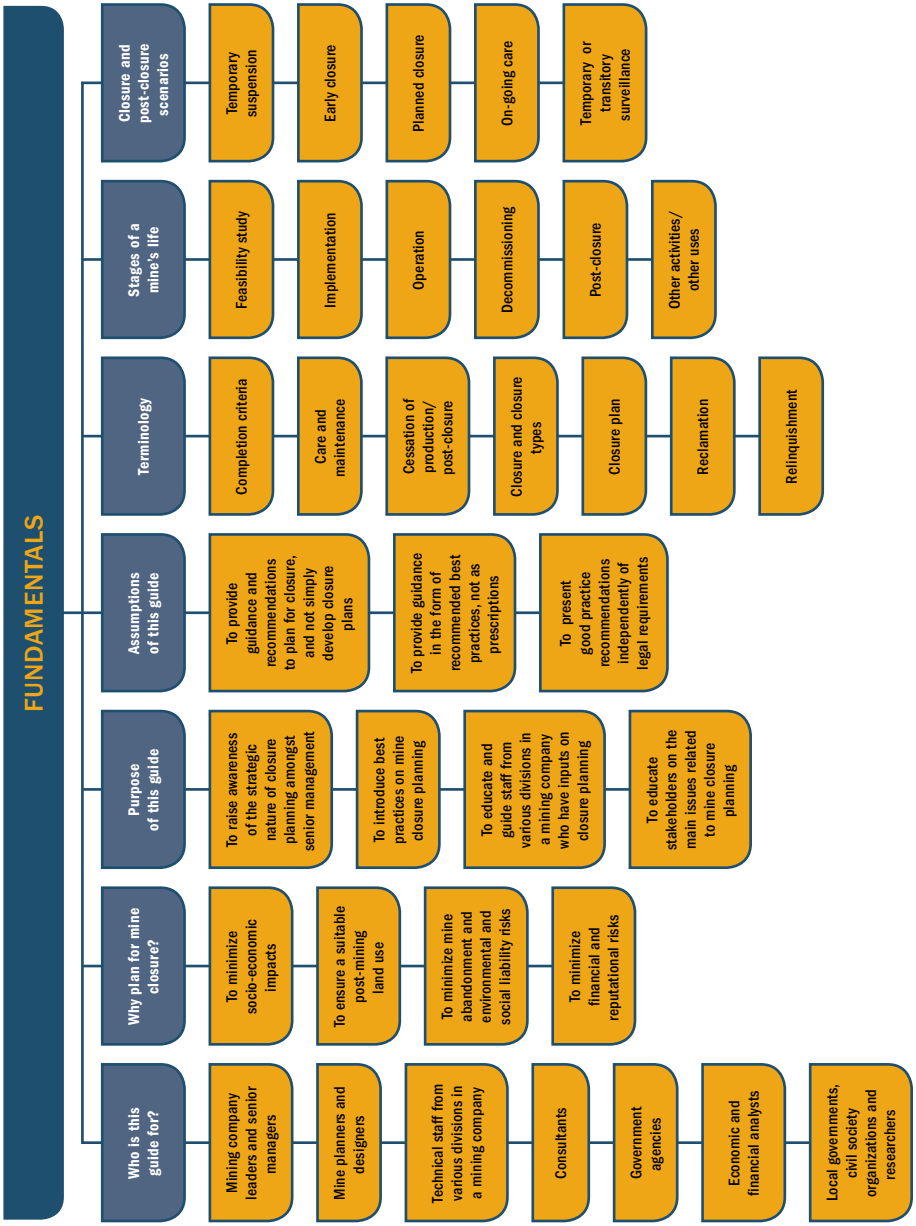
7. The closure plan should be updated whenever there are substantial changes to the mining project or conditions in the surrounding area

Many changes occur during the life of a mine. On one hand, there are internal changes, such as changes to the mining plan, expansion of mineral reserves, development of new technological processes, management or shareholder control changes, accidents,

etc. On the other hand, changes may also occur in the external environment. Ore prices fluctuate, regulations may evolve, and community expectations may change. Revision and update of the Closure Plan should obviously reflect major changes, but it is not sufficient to update the Plan – one should have a system in place that will flag update or revision needs. Thus, mining companies are supposed to adopt procedures for monitoring changes that can have an impact on closure. In addition to changes in mining plans or technological innovations, planning for closure may require revision and update when key external changes occur such as regulatory changes, the involvement of new stakeholders or changes in the views or values of stakeholders already involved, among other causes.

The Guide provides general advice, but does not offer solutions to individual cases. Implementation of the guidelines requires professional interpretation and adjustment not only on a mine-by-mine basis, but also to corporate culture.

GRAPHIC ABSTRACT



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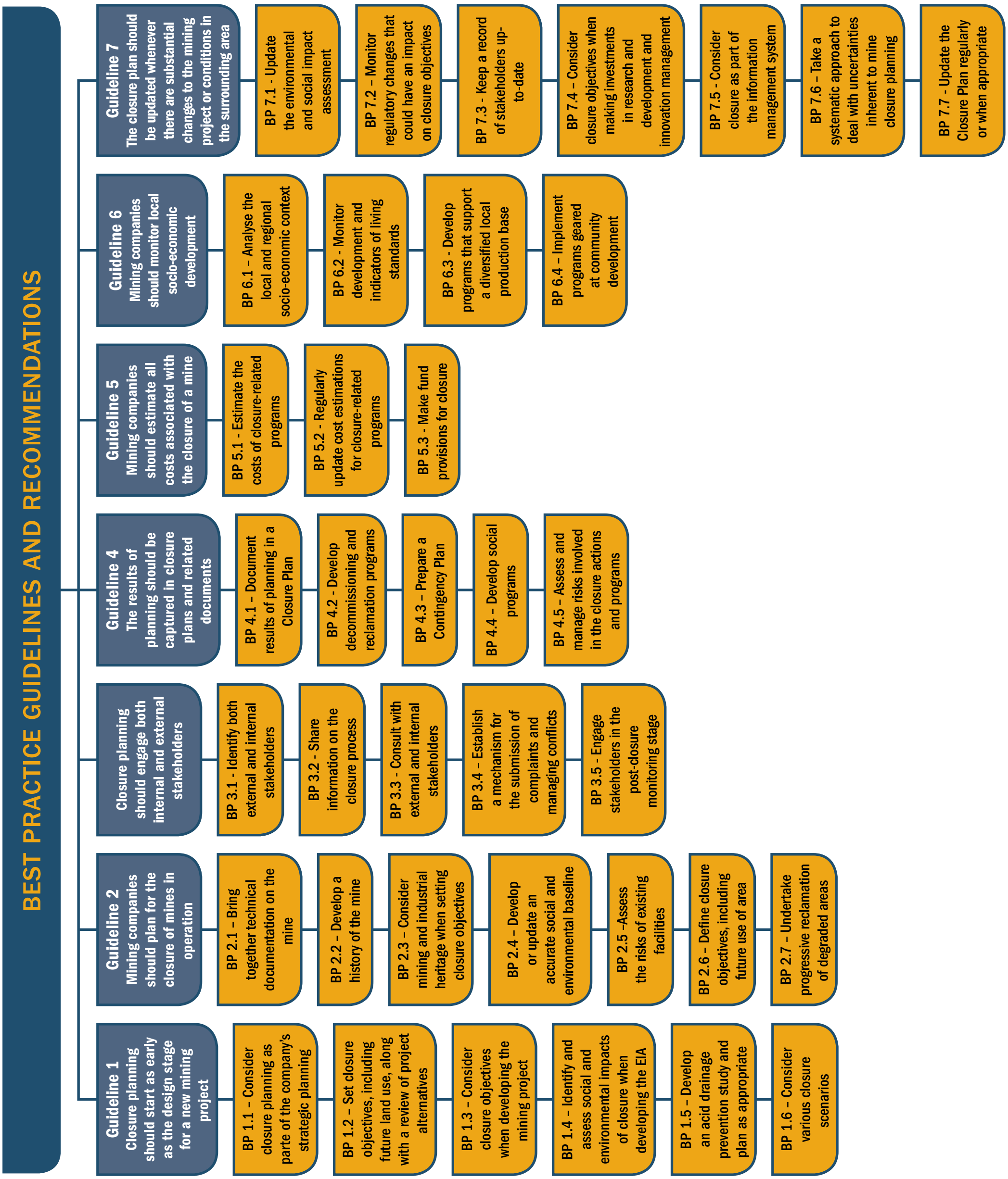

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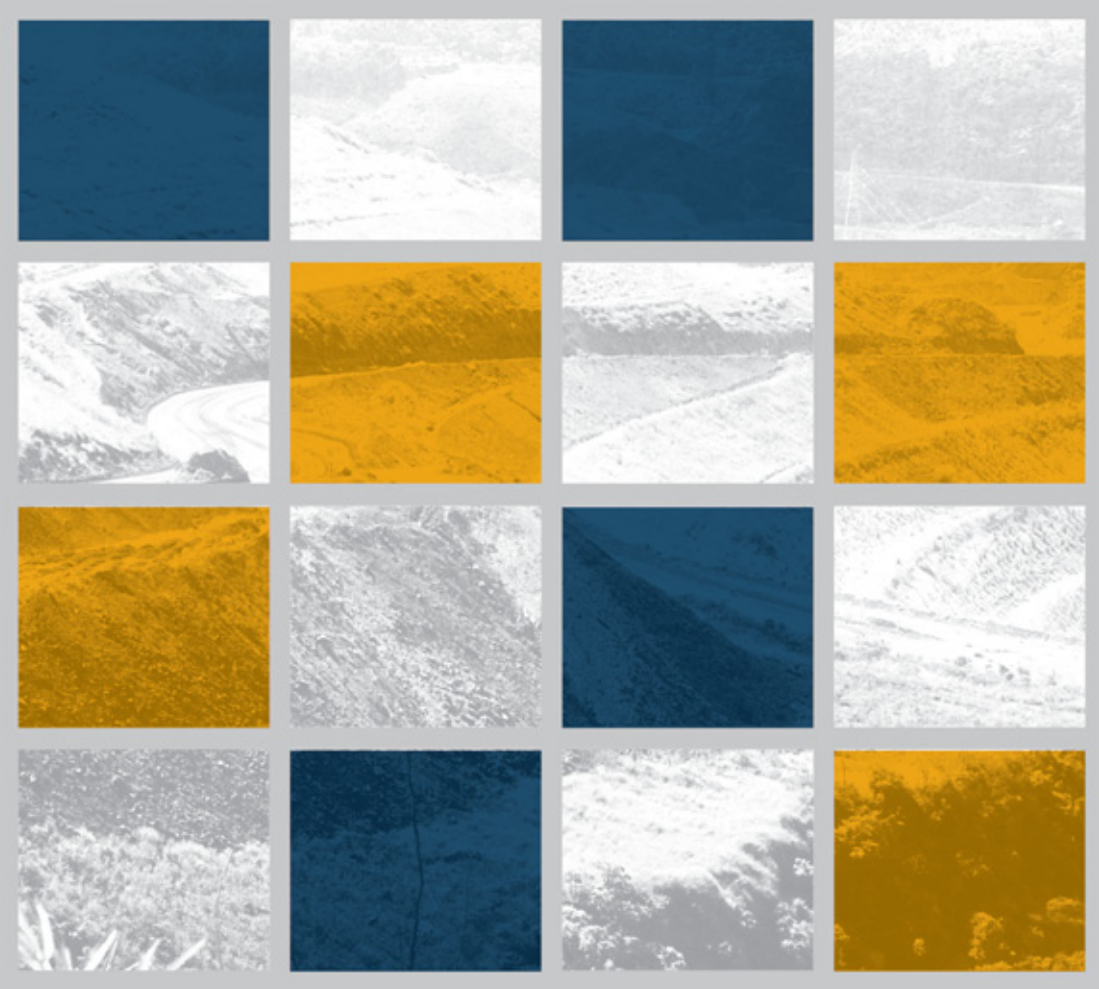


FUNDAMENTALS

1 WHO IS THIS GUIDE FOR?

Mine closure has become a hot issue over the past few years. Mining companies have been preparing closure plans, regulators have started imposing requirements on companies to plan for closure, some international conferences focus entirely on the topic, and guides have been published in some countries. However, very few mines have been closed according to some preconceived plan, closure actions are still confused with actions to rehabilitate disturbed areas, experience is still rarely shared with industry professionals and the knowledge gained in this domain still lacks a systematic approach. Mine engineering manuals published twenty years ago did not even mention decommissioning or closure as stages or milestones in the lifetime of a mine. Only this subject began to appear in mining engineering courses, but still very modestly.

The purpose of this Guide is to gather relevant knowledge on the topic and present it in summary form. Although tailored to the Brazilian context, the recommended approach and the best practices can be applied internationally. Guidelines are provided in order to help mainstream issues relating to mine closure, from planning a new mining project to its operational phase, as well as to plan for the closure of operating mines.

This guide is intended for mining professionals and anyone interested in the sustainability of a business that is vital to the economy and the contemporary style of development.

Leaders of mining companies – in technical, financial, human resources, social responsibility, and planning roles – can have a synoptic view of the implications of closure planning as a strategic issue for a mining company.

Mine planners and designers will find guidance on how to incorporate, in a systematic and structured manner, the perspective of a mine's lifespan into their plans and projects, considering the end of its useful life, even at a distant time horizon.

Mine managers, planning teams, prospecting and exploration personnel, experts in specialized areas such as geotechnics, processes and development, monitoring, reclamation of degraded areas, social responsibility, procurement, accounting, and control (and a number of other areas) can understand the interrelationships between closure planning and all mine planning and operation functions.

Consultants in technical, environmental, social, and sustainability domains will find a summary of international best practices and supporting references to learn more on the topics.

Government agencies can use the guidelines in this Guide to inform their analysis of new projects and establish requirements to the construction, operation or decommissioning phases of a mine.

Economic and financial analysts will find updated guidelines and recommendations that facilitate consolidation of total costs and allow for a more consistent analysis of investment risks.

Local governments and civil society organizations will find information on best practices related to closure planning, as well as guidelines to monitor companies operating in their regions by preparing to engage and interact with the companies themselves and other actors.

Finally, researchers may find inspiration to identify and define new research problems on a topic that has not yet been extensively studied.

Most recommendations apply to large and small mines alike and to businesses of all sizes. Although some best practices in this Guide may be difficult to implement, or even not applicable to some small mining

companies or even small mines owned by large firms, they may help to make decisions and develop specific plans or actions.

The Guide provides general advice, but does not offer solutions to individual cases. This is not, therefore, a manual to be referred to for pre-defined answers, but a set of guidelines whose implementation requires professional interpretation and a case-by-case approach that is tailored to the corporate culture. Nor does this Guide focus on approaches to abandoned and orphaned mines, since an assumption of the very concept of closure planning is to avoid abandoning exhausted mines.

2 WHY PLAN FOR MINE CLOSURE?

Opening a new mine is the culmination of a long process, the result of the work of several people over many years. Identifying ore-bearing locations; carrying out geological field surveys; laboratory tests and computational modeling are some of the tasks performed in the early stages of work.

When ore is proved to exist in a given location, which only happens in a small percentage of cases, an assessment of the market, transportation routes and means of concentrating the ore becomes a part of the technical and economic feasibility study, which also includes an environmental feasibility assessment, thus defining the main conditions to be taken into consideration in the conceptual design and evaluation of alternatives.

Once this stage is complete, and provided that the project is technically, economically and environmentally feasible, it goes through successive detailing stages, which generally involve conducting detailed geological studies that include borehole sampling; bench or pilot plants essays in order to test routes for ore processing; simulation of alternative mining plans; cost estimates and financing alternatives; detailed environmental, social and cultural resources surveys; project adjustments and modifications to avoid or minimize adverse social and environmental impacts; identification of stakeholders and communication with the local community; among many other tasks.

Thus, the development of a mining project is not the exclusive job of a dedicated team of professionals. It involves engaging with the local community and various other stakeholders, compliance with legal requirements – in particular those set forth in mining and environmental regulations –, and raising the necessary funds to cover the planned investments.

Compliance with environmental legislation requirements – especially obtaining an environmental license – involves conducting specific environmental impact assessments and public consultations. On the other hand, meeting the conditions of funding agents increasingly involves an analysis of social and environmental risks.

One can see, therefore, that opening a new mine is no easy task and requires a long maturation period, participation of multiple stakeholders and fulfillment of various requirements. Why shouldn't mine closure be equally appreciated?

There are many reasons why companies, government authorities and civil society organizations should consider closing a mine as important as opening it:

1. Opening a mine could mean a significant change to the host community. Mine closure can also pose major adverse socio-economic impacts to the community, with job losses, small businesses shutting down, declining municipal tax revenues and deterioration of public services.

2. Every mine changes the environment significantly, and often permanently. However, mining is a temporary form of land use. Once operations have ceased, new uses for the areas in the mining lease should be feasible, considering both the restrictions and the opportunities arising from permanent physiographic changes, as well as the opportunities resulting from local development boosted by the operational phase.

3. Mines are negotiable assets. Liabilities incurred by the company that opened the mine need to be taken up by its successors. If the conditions to be met for closure are not clearly established as soon as possible, the risk of abandonment or of bequeathing environmental and social liabilities is heightened.

4. Closure involves costs that should be known in advance by the company, financial institutions and government agencies. Planning for closure from the beginning of a project helps business leaders to make technical decisions that facilitate closure and are viable and cost-effective.

5. Closure entails risks for companies and communities; if mishandled, it can be harmful to a company's reputation and result in higher costs than a properly conducted closure; planning for closure helps to know and manage the residual risks of closure actions.

Showing the ability to open, operate, and close a mine in accordance with best practices is a company's cornerstone for obtaining a social license to operate. In the past, abandonment was the only option available. From the 1970s and 1980s, the requirement for rehabilitating disturbed areas started to be considered an integral part of any mining business. In recent times, the concern for building a positive legacy for the host community came into question, as well as the concern to achieve a positive net balance in terms of protecting biodiversity at the end of a mine's operations.

Hence, there is growing recognition not only that closure is an undisputed fact in a mine's lifespan, but that successful closure depends on planning in advance – as judiciously and carefully as planning for its start – and on implementation taking place concurrently with the operation of the mine. Tackling successfully such a challenge requires a profound change in the culture of mining companies and project teams.

3 DEVELOPING THIS GUIDE

Preparation of this Guide for Mine Closure Planning involved the array of tasks summarized in Figure 1. Guides developed for international audiences and a number of guidebooks explaining requirements of certain jurisdictions have been used as a preliminary references for best practices and general guidance on mine closure planning.

IBRAM staff collaborated with the authors to define the main topics to be covered in the Guide and how they should be addressed. From the beginning, it was decided that the goal was to prepare a guide to **plan for closure**, as opposed to a guide to prepare a **closure plan**. This is a key foundation of this Guide. While recognizing the paramount importance of every mine having a closure plan, the process of planning for closure is even more important. In order to succeed, it is crucial that such a plan be the culmination or the result of the commitment of the mining company's senior management. Therefore, closure planning should be considered as a strategic action by the company.

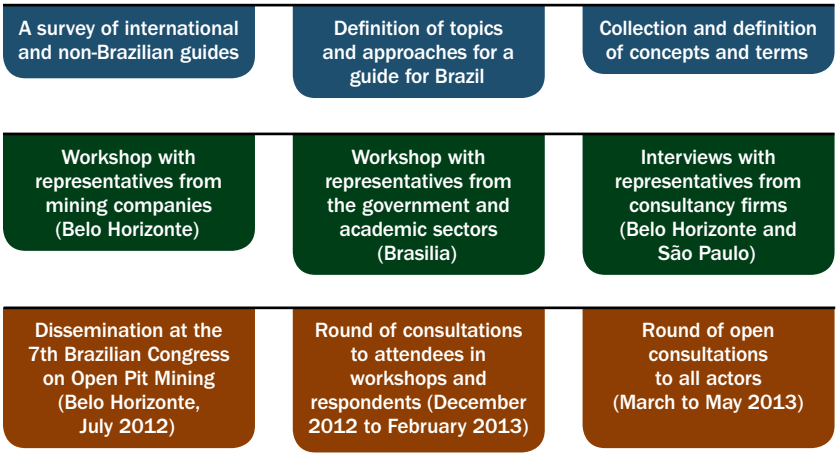
Then the meaning of key terms used in the Guide (Chapter 4) was defined, including a description of the stages in the lifetime of a mine (Chapter 5). As there is no consensus or consistency on the use of these terms in Brazil or in the international technical literature, it is vital to make the definitions used in this Guide clear from the outset. The notion of closure does not have a meaning that is widely shared by mining professionals.

Once the conceptual basis and goals of the Guide were established, work on the actual development started. Two workshops were held – in Belo Horizonte and Brasília –, which brought together delegates to discuss key issues in mine closure planning in Brazil. The workshops had ambitious objectives: (1) to identify the main problems affecting

mine closure planning in Brazil; (2) to collect examples of best practices adopted in Brazil for mine closure planning (such as corporate standards or procedures, cases of successful community engagement, etc.); and (3) to identify key gaps – knowledge, communication or regulatory – which hinder enhancement of closure planning practices.

In Belo Horizonte, the workshop brought together only representatives from mining companies. Its primary purpose was to meet objectives (1) and (2). In Brasilia, the workshop brought together representatives from the government and academic sectors, and the main purpose was to meet objectives (1) and (3). In both workshops, inputs were noted and discussed.

Figure 1: Steps in the preparation of this Guide



Inputs were collected from consultants with experience in preparing mine closure plans through interviews conducted during visits to their offices. Representatives from two companies based in Sao Paulo and four companies based in Belo Horizonte were interviewed. Identifying best practices already in place in Brazil was one of the objectives, as well as understanding the views of consultants on the main problems associated with this type of service.

This was followed by contacts with companies attending the workshops or mentioned by the respondents in order to obtain a brief description of examples (referred to as "cases" in this Guide) related to closure that could serve as a reference, inspiration or simply as a record of best practices implemented in Brazil. Some cases studied were included in this Guide with the consent of the company involved. Each case illustrates one of the recommended practices.

At the 7th Brazilian Congress on Open Pit Mining held in Belo Horizonte in July 2012, a presentation was made on the ongoing guide development of the Guide and an opinion poll was conducted as an opportunity for delegates to provide their feedback.

Following the workshops and interviews a draft of the Guide was prepared, improved by comments received during the conference. This revised draft was circulated to all those who attended the workshops and interviews, as well as those who expressed their interest during the conference (first round of consultation).

The comments received during this round were taken into consideration in the review and preparation of a new version of the Guide, which, in turn, was made available for public consultation in March and April of 2013 through IBRAM's website along with a form for submitting feedback. The feedback deadline was extended to mid-May. This second round of consultations was available to anyone interested, and it was actively publicized by IBRAM among professional and academic networks, companies, government agencies, and civil society organizations. Important feedback was received at all stages of the consultation, and much of it was used to enhance the contents or clarify certain best practice recommendations.

IBRAM and the authors would like to thank all workshop attendees, interviewees and commentators, as well as companies that had representatives attending the workshops and provided inputs to cases.

4 PURPOSE AND ASSUMPTIONS

The primary reasons for preparing this Guide were the recognition of the growing importance of the topic, international concern with issues relating to mine closure, increasing regulatory requirements in Brazil, and also Brazil's unique features in both large- and small-scale mining, as well as little experience in mine closure in Brazil.

At the international level, special mention should be made of the final declaration of the Rio+20 Conference - United Nations Conference on Sustainable Development called "The Future We Want". It states in paragraph 228:

> 228. We recognize the importance of strong and effective legal and regulatory frameworks, policies and practices for the mining sector that deliver economic and social benefits and include effective safeguards that reduce social and environmental impacts, as well as conserve biodiversity and ecosystems, including during postmining closure.

There is no doubt, therefore, as to the current controversy surrounding this issue. Its importance goes beyond the scope of mining companies or their relationship with government agencies.

Against this backdrop, the purposes of this Guide are:

- to raise awareness of the strategic nature of closure planning among senior corporate managers;
- to introduce best practices on closure planning;

- to inform and guide practitioners from various divisions of a mining company who have an input to planning closure; and
- to inform stakeholders on the main issues related to mine closure planning.

Therefore, it is not a Guide on the preparation of closure plans (although it also contributes to this task), but to help plan for closure and the post-closure period. The distinction is not simply of a semantic nature or subtle. It's a fundamental distinction, and it is important to explain it to clarify its seminal importance and to make readers aware of this initial assumption in the Guide. When companies make efforts to prepare documents to meet external requirements, they tend to disregard its materiality to their internal processes. In such situations, companies typically hire consultants for the preparation of documents, but few of them engage their own staff or, when they do, they simply use staff from areas such as government relations or stakeholder relations. By doing so, they might end up making any potential beneficial effects void.

For this reason, the first recipients of this Guide are mining company high-level managers, as described in Chapter 1. Closure planning is of a strategic nature, and so is plays a central role, and is not an "additional" or merely formal concern. On the other hand, closure planning obviously involves a number of technical tasks, and this is the focus of the bulk of this Guide, in the form of best practice recommendations.

Not all best practices will be useful to all companies, and not all will be used simultaneously, but implementation of any of them requires professional judgment and the involvement of multidisciplinary teams. Thus the objective was not to develop a manual, but a guide with advice, not prescriptions. This was the second assumption underlying its development.

The third assumption of this Guide was to restrict itself to identifying best practices and explaining why they are important, using examples where possible. It is beyond its scope to discuss, review, critique, or suggest changes to laws or regulations. Therefore, no mention is made of legal requirements. Moreover, it is believed that regulations can and should evolve rapidly.

The outlook is that closure planning is increasingly becoming an influential theme in the decisions of mining companies and regulatory bodies, and this Guide is intended to help improve this process.

ASSUMPTIONS

1. **Providing guidance and recommendations for closure planning, and not merely to prepare closure plans. The planning process and its impact on project decisions and operations are more important. The plan simply documents the results of planning.**

2. **Providing guidance in the form of best practice recommendations, not as prescriptions. Recommended best practices can only be implemented by transferring and adapting them to the individual mines after a professional evaluation has been performed.**

3. **Providing guidance and recommendations regardless of legal requirements. The Guide discusses best practices that may or may not be required by law.**

5 MINE CLOSURE TERMINOLOGY

The terminology used in mine closure planning is still controversial and largely ambiguous. Guides published in different countries fail to be consistent in their use of terms and concepts related to mine closure. Likewise, the technical literature does not provide consistency in terms of concepts. For such reasons, the key terms directly related to closure used in this Guide are described and defined here. Additional terms are provided in the Glossary.

Care and maintenance

Cessation of mining operations - usually for technical or economic reasons - when there is reasonable expectation that operations can be resumed.

Cessation of production

End of a mine's production activities.

Closure

End of a mine's decommissioning activities.

Closure objectives

Future state to be achieved after **closure** of a mine.

Closure plan

A document that provides guidance to a mining company and other relevant stakeholders, establishes **closure objectives** and describes the actions to be taken to achieve them.

Completion criteria — The set of parameters, indicators or conditions that must be met so that **closure objectives** can be considered as fulfilled; satisfactory compliance with the completion criteria allows for **relinquishment**.

Decommissioning — Stage in the life of a mine that begins shortly before the end of mineral production (**cessation**) and is completed with the removal of all unnecessary facilities and implementation of actions to ensure the area is secure and stable, including environmental reclamation and social programs; it is possible to decommission individual **structures** in a mine still in operation, such as waste rock dumps and tailings dams.

Early closure — Cessation of mineral production activities before the date indicated in the **Closure Plan**.

Mine closure planning — Progressive preparation of a company for the decommissioning of a mine, transition to the **post-closure stage** and **relinquishment**. This process starts in conjunction with mine opening planning and continues into the operating stage.

Monitoring and maintenance — Actions taken during the period of **care and maintenance** - or suspension of activities in a mine - that are intended to maintain facilities and structures in order to enable resumption of production.

Planned closure — Cessation of mineral production activities in accordance with the **Closure Plan**.

Post-closure — The phase that takes place after full implementation of decommissioning, and includes actions such as monitoring, maintenance and social programs towards achieving **closure objectives**.

Reclamation — A generic term that refers to management techniques designed to make a degraded area fit for new activities; reclamation is a broad concept that encompasses different objectives or levels of reclamation to be achieved, including rehabilitation, ecological restoration and remediation of contaminated areas.

Relinquishment — Transfer of responsibility for caring for the area to a third party, usually after compliance with legal obligations and **completion criteria**.

6 STAGES OF A MINE'S LIFE

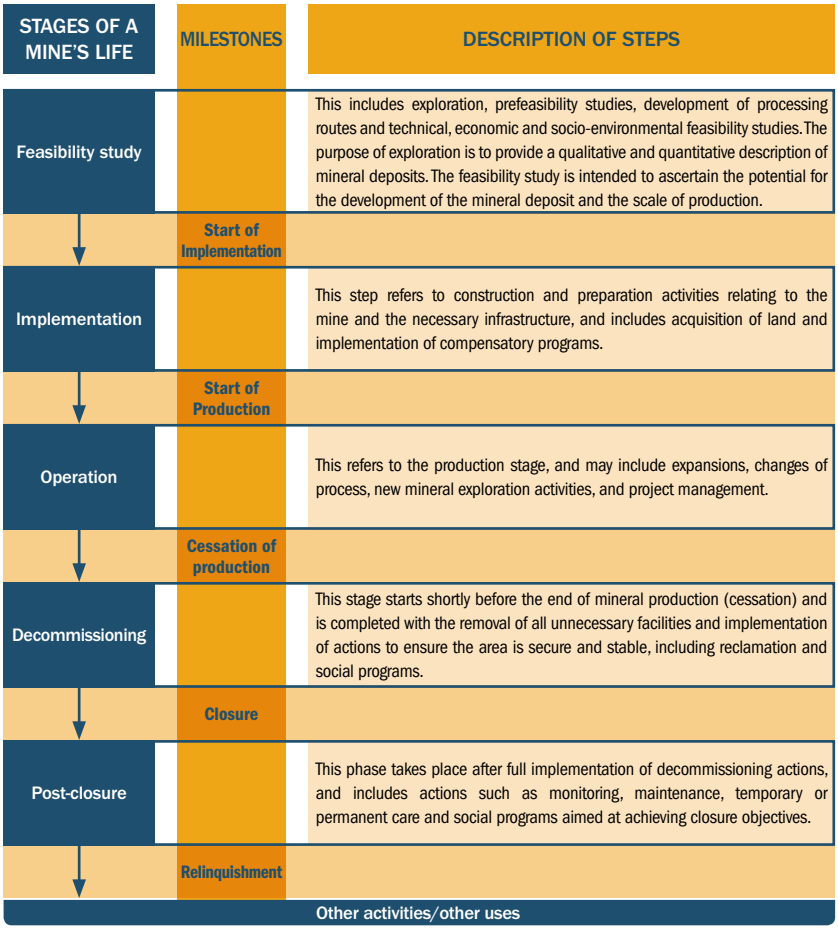
A clear and unambiguous terminology to describe the various stages of life of a mine is not available neither in Brazil nor internationally. For the sake of linguistic precision, the stages outlined in Figure 2 are used here. It should be noticed that to plan the opening of a new mine, it is customary to break down the initial stage – referred to as feasibility study – by subdividing it into several steps or substeps. For the purposes of closure planning, there is no need to subdivide this phase. On the other hand, the post-operation phase is divided into two major stages – decommissioning and post-closure –, which are each marked by two events: cessation of production and actual closure.

Figure 2 shows milestones or key events in the life of a mine. For the purposes of planning, five of these milestones have been highlighted: start of deployment, start of production and operation, and cessation, followed by closure and relinquishment. According to this approach, closure is not a stage, but an event that indicates complete and satisfactory implementation of the necessary actions to ensure that the mine area can be handed over for a new land use. At this milestone starts the post-closure stage, during which the mining company still has obligations to fulfill before it can relinquish the area to a third party. It should be noted that the Guide does not go into the merits of legal responsibility of the mining company after relinquishment, and does not discuss any other obligations or legal implications.

Between start and cessation of production, Figure 2 does not indicate other major events, but it is known that in the case of some mines production can be stalled and then resumed. This can have important implications for closure, and will be discussed in Chapter 7 - Closure and Post-Closure Scenarios.

Considering that **planning for closure** involves primarily careful preparation for the decommissioning and post-closure stages, a clear agreement between experts in the academic community and industry practitioners is that closure must begin to be thought out and planned before the mine is opened. This Guide echoes this advice.

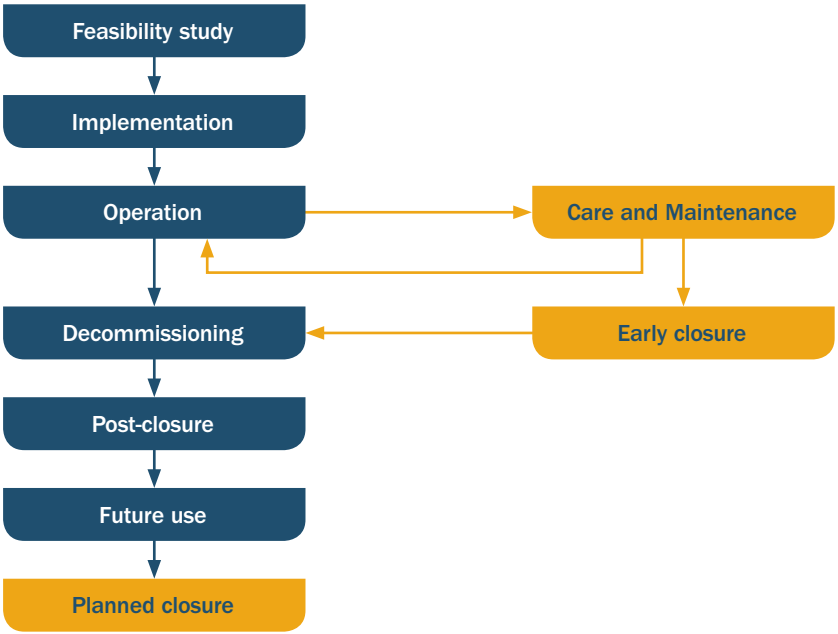
Figure 2: Stages of a mine's lifecycle



7 CLOSURE AND POST-CLOSURE SCENARIOS

Figure 2 outlines a linear sequence of stages and milestones of a mine's life. In many cases, however, the sequence is interrupted during its operation or even during the implementation step. Figure 3 depicts distinct sequences observed in some mines. The default scenario for mine closure planning is shown on its left-hand side, and it is here referred to as planned closure, where ore is continuously mined according to the mining plan, which is duly updated as appropriate.

Figure 3: Stages of a mine's lifecycle and planned closure, care and maintenance, and early closure scenarios



Care and maintenance means a situation when for some reason a mining company decides to stop production and expects to resume it in the foreseeable future. There are various reasons why a mining company is prompted to halt production at a mine, which can be of an economic, marketing, or technical nature. If operations are resumed, closure will occur at some future time in accordance with a closure plan. During the care and maintenance period, the company continues to take care of the area.

Figure 3 shows, on its right-hand side, an early closure scenario, where cessation of production occurs ahead of schedule. Under this scenario, the company has no interest in maintaining its activities and is expected to decommission the mine. Early closure is rarely a clear cut decision made during the operation stage. In most cases, the company will choose to put activities on care and maintenance and assess market and other conditions before deciding for early closure.

Early closure is very common in the mining industry. There are multiple reasons leading to this situation, and not all are under the control or influence of the company, as shown in Table 1. Early closure should be understood as one that occurs before the date specified in the Closure Plan (as defined in Chapter 4). Mining professionals are used to cope with the extended life of a mine, which can result from investments in exploration made during the operation stage. Since mining is a risky business (economic risk that investments in exploration will generate no return), it is usual practice in the industry to invest enough to spot mineral reserves that ensure a mine will be economically viable for a period. Yet an increase in reserves and the continued life of a mine does not eliminate or even reduce the risk of early closure, whose causes are diverse (Table 1).

Table 1: Primary causes of early mine closure

(i)	Declining prices of mineral commodities.
(ii)	Market restrictions for certain minerals due to health reasons (such as asbestos), competition with other materials or technological changes that lead to obsolescence of industrial processes that consume certain minerals.
(iii)	Operating accidents or incidents, such as failure of tailings dams or slopes, or collapse of underground excavations.
(iv)	Business decisions arising from the sale of assets, mergers or acquisitions, or a change in shareholder structure.
(v)	Extreme external events resulting from geological and atmospheric processes or climate change.
(vi)	Changes in government policies, such as tax increases, changes in environmental legislation, administrative decisions spurred by community pressure or court decisions.
(vii)	Poor geological knowledge of the ore body.
(viii)	Design errors that result in operational hurdles or increased costs.
(ix)	Fraud or other illegal business practices.
(x)	Costs for the contingency plan and care and maintenance actions during temporary suspension.

Source: Sánchez (2011)

Extending the life of a mine entails updates to the closure plan, but if closure planning for a mine fails to consider the possibility of early closure, it will be flawed. There are additional difficulties in preparing companies for early mine closure, such as the short timeframe to implement decommissioning programs, the need to bring forward actions for reclamation and socio-economic programs for the local community. Early closure of a mine without the company being properly prepared could have negative consequences for the community, the environment and the company itself.

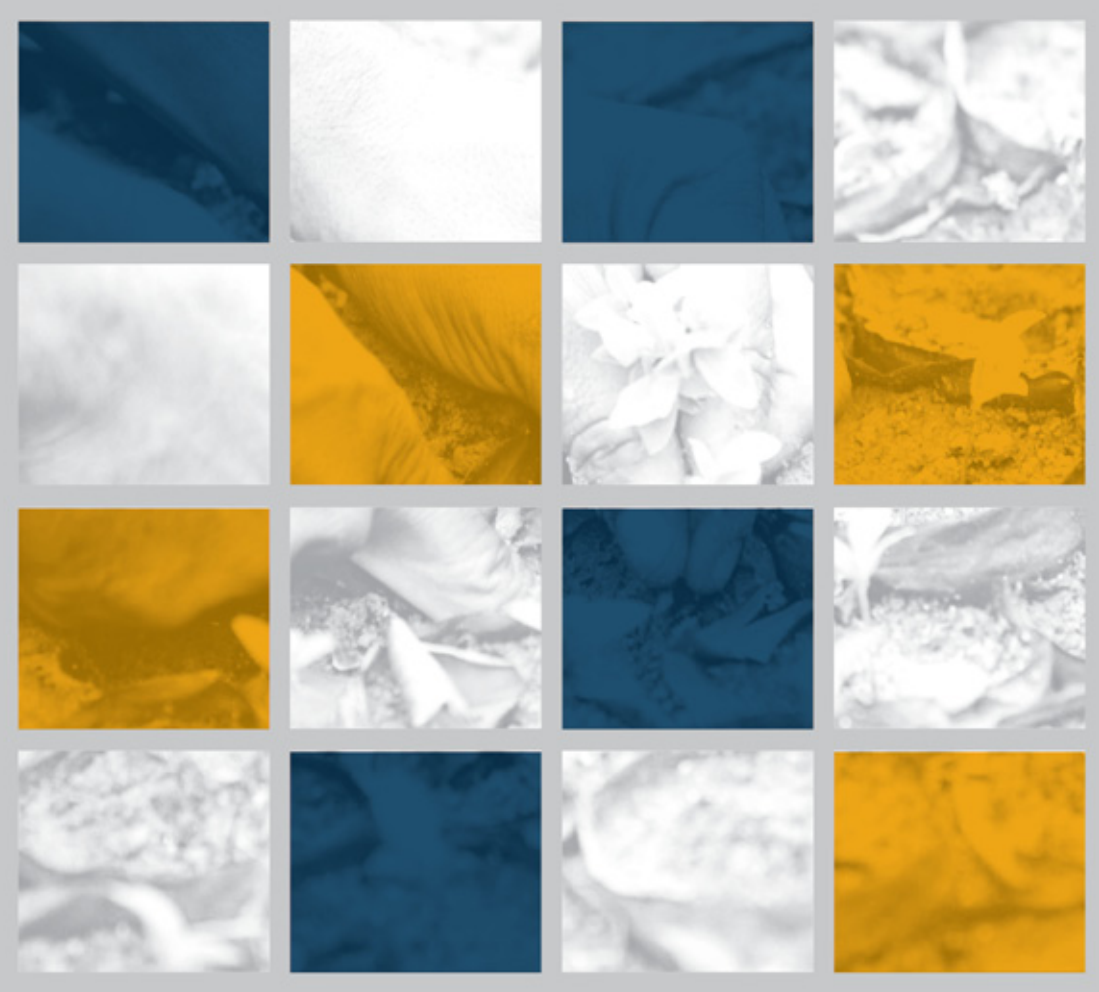
Planning should also consider scenarios for the post-closure stage. At this stage actions such as monitoring, site inspections, maintenance, surveillance and social programs aimed at achieving closure objectives are performed. There are two main post-closure scenarios:

- **Permanent care**, which calls for the presence of the company to implement actions required to achieve closure objectives that may last for several years. A typical condition requiring permanent care is the operation of acid water treatment systems from waste rock dumps, tailings dams and pit lakes. This scenario is also known as "active care".

- **Temporary or transitional care**, when the necessary actions are limited to tasks such as inspections, environmental and geotechnical monitoring, repair of drainage systems, maintenance of revegetated areas, etc. that may be wholly conducted during the post-closure stage. This latter scenario usually requires one-off actions or a few visits to the area, but it may also require ongoing care. Systems referred to as "passive treatment" such as wetlands to control acid drainage and natural attenuation, reactive barriers, and other actions for the remediation of contaminated areas are often called "passive care".

The permanent care scenario should result in a contractual or legal commitment to transfer responsibility for continuity of the actions imposed on the new party responsible for the area after relinquishment. The temporary care scenario, in turn, supports relinquishment, since the new party in charge will not inherit significant liabilities. Therefore, it is important to establish criteria for differentiating situations that require ongoing, permanent care from those that can be managed through temporary care.

PART 2



BEST PRACTICE GUIDELINES AND RECOMMENDATIONS

8 CLOSURE PLANNING BEST PRACTICES

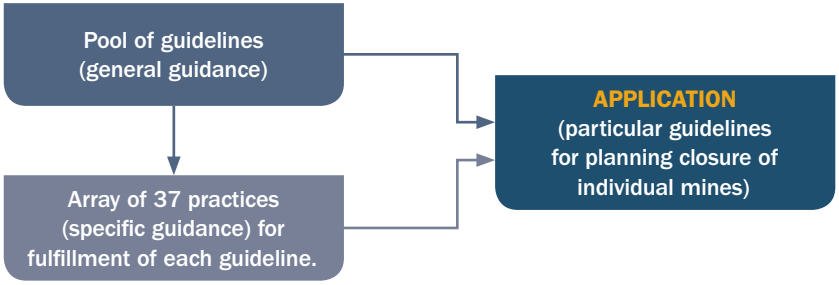
The best practice recommendations contained in this Guide are divided into seven groups, called guidelines for closure planning. Recommended practices were sourced from (1) international guidelines for mine closure planning; (2) practices collected from mining companies that operate in Brazil; (3) the closure planning needs identified during the workshops and interviews; and (4) those referenced in other literature sources.

As a result, 37 most relevant practices were selected. These practices are described in this chapter, alongside a brief explanation and additional sources of information. Wherever possible, real examples for Brazil (collected as this Guide was developed) or hypothetical situations that illustrate the application of these practices are provided.

These guidelines and practices are intended to assist mining companies and other stakeholders to better plan for the closure of mines in operation and to include closure among the items to be considered when making a decision on the opening of new mines. However, a guide cannot provide specific advice for individual mines, which can only result from studies conducted on a case-by-case basis. Figure 4 illustrates the Guide's design and its application.

The guidelines provide general guidance for planning closure, while the best practices statements describe ways the guidelines can be applied, i.e., guidance to turn the guidelines into actions and initiatives that can be implemented by the individual companies. Although the target audience for this Guide are different stakeholders and mining professionals, the key players in mine closure planning are mining companies, reason for which best practices are presented as recommendations to companies, who are expected to apply them in

Figure 4: Design of the Guide for Mine Closure Planning



a particular way to their mine(s) or new mine project(s) by tailoring them, if necessary, to the uniqueness of each mine in its environmental and social context. Thus, the Guide focuses on guidance of a general nature (guidelines) and of a specific nature (best practices). Their implementation involves interpreting the recommendations provided in the Guide by looking at the best way to apply them, i.e., directly (when appropriate and subject to adjustments) or by adapting them to the corporate culture and internal processes, thus transforming these guidelines and best practices into particular guidance.

Many if not most of the guidelines and best practices apply to mines of all types and to businesses of all sizes. However, there are mines of very diverse characteristics, ranging from quarries in urban areas where the real estate market is buoyant to large metal mines that are the basis of the economy of small towns, and to mines located in areas that are vitally important for biodiversity conservation. Thus, the implementation of the practices recommended here can only be selective, and cannot be done without a careful case-by-case assessment.

It is important to remind that the Guide clearly deals with closure planning, rather than the preparation of closure plans. Anyone aiming at applying the guidelines and practices recommended in this Guide should be aware of this key conceptual distinction.

The seven guidelines discussed here are:

1. Closure planning should start as early as the design stage for a new mining project.

2. Mining companies should plan for the closure of mines in operation.

3. Closure planning should engage both external and internal stakeholders.

4. The results of planning should be captured in closure plans and other related documents.

5. Mining companies should estimate all costs associated with the closure of a mine.

6. Mining companies should monitor local socio-economic development.

7. The closure plan should be updated whenever there are substantial changes to the mining project or conditions in the surrounding area.

Table 2 shows the list of all practices that are described in the following sections.

Table 2: Mine closure planning guidelines and best practices

Guidelines	Best practices	
1. Closure planning should start as early as the design stage for a new mining projec	Best Practice 1.1	Consider closure planning as part of the company's strategic planning
	Best Practice 1.2	Set closure objectives, including future land use, along with a review of project alternatives
	Best Practice 1.3	Consider closure objectives when developing a mining project
	Best Practice 1.4	Identify and assess social and environmental impacts of closure when developing the Environmental Impact Assessment for the project
	Best Practice 1.5	Develop an acid drainage prevention study and plan as appropriate
	Best Practice 1.6	Consider various closure scenarios
2. Mining companies should plan for the closure of mines in operation	Best Practice 2.1	Bring together technical documentation on the mine
	Best Practice 2.2	Develop a history of the mine
	Best Practice 2.3	Consider mining and industrial heritage when setting closure objectives
	Best Practice 2.4	Develop or update an accurate social and environmental baseline
	Best Practice 2.5	Assess the risks of existing facilities
	Best Practice 2.6	Define closure objectives, including future land use
	Best Practice 2.7	Undertake progressive reclamation of degraded areas
3. Closure planning should engage both external and internal stakeholders	Best Practice 3.1	Identify both external and internal stakeholders
	Best Practice 3.2	Share information on the closure process
	Best Practice 3.3	Consult with external and internal stakeholders
	Best Practice 3.4	Establish a mechanism for the submission of complaints and managing conflicts
	Best Practice 3.5	Engage stakeholders in the post-closure monitoring stage

Guidelines	Best practices	
4. The results of planning should be captured in closure plans and other related documents	Best Practice 4.1	Document results of planning in a Closure Plan
	Best Practice 4.2	Develop decommissioning and reclamation programs
	Best Practice 4.3	Prepare a Contingency Plan
	Best Practice 4.4	Develop social programs
	Best Practice 4.5	Assess and manage risks involved in the closure actions and programs
5. Mining companies should estimate all costs associated with the closure of a mine	Best Practice 5.1	Estimate the costs of closure-related programs
	Best Practice 5.2	Regularly update cost estimations for closure-related programs
	Best Practice 5.3	Make fund provisions for closure
6. Mining companies should monitor local socio-economic development	Best Practice 6.1	Analyse the local and regional socio-economic context
	Best Practice 6.2	Monitor development and indicators of living standards
	Best Practice 6.3	Develop programs that support a diversified local production base
	Best Practice 6.4	Implement programs geared at community development
7. The closure plan should be updated whenever there are substantial changes to the mining project or conditions in the surrounding area	Best Practice 7.1	Update the environmental and social impact assessment
	Best Practice 7.2	Monitor regulatory changes that could have an impact on closure objectives
	Best Practice 7.3	Keep a record of stakeholders up-to-date
	Best Practice 7.4	Consider closure objectives when making investments in research and developmentyand innovation management
	Best Practice 7.5	Consider closure as part of the information management system
	Best Practice 7.6	Take a systematic approach to deal with uncertainties inherent to mine closure planning
	Best Practice 7.7	Update the Closure Plan regularly or when appropriate

GUIDELINE 1

CLOSURE PLANNING SHOULD START AS EARLY AS THE DESIGN STAGE FOR A NEW MINING PROJECT

This is actually the basic principle followed in various types of documents on mine closure, from laws and regulations to international manuals and guides for specific jurisdictions. Closure planning starts with the feasibility study for a new mine, so that the options for post-mining land use are considered at the same time as project development alternatives. Terms such as "designing for closure" or even "designing for post-closure" have been used to describe the adoption of this guideline by the teams involved in the feasibility study and development of mining projects.

Full implementation of this guideline is justified by the fact that mining is a temporary land use, which will give way to alternative uses in the future. There is no doubt that the planning horizon is uncertain and can be long. It is uncertain because the life of a mine may often span several years in excess of the timeframe considered in the preparation of the opening project. It is not unusual for mining companies to invest in mineral exploration activities during the operational phase, often resulting in expanded mineral reserves. Furthermore, they also invest in the development of technology that makes it possible to use lower grade ore or even to concentrate tailings. In the past, similar arguments were used to justify passing on to future generations the burden of closing mines, reclaiming degraded areas or developing economic diversification projects.

Such arguments no longer make sense, and will not meet the public's expectations regarding the responsibility and role of companies. Mining companies actually have the ability to plan into the future and guide their actions towards achieving predefined goals. It is becoming commonplace in major mining countries to require a concept of

closure as part of the studies required when a company apply for authorization to start a new project.

Full adoption of this guideline may have profound implications for the feasibility analysis of new projects. Investment decisions should take into account and be influenced by the costs and technical feasibility of the actions involved in the closure stage.

The following six practices help to implement this guideline:

Best Practice 1.1 Consider closure planning as part of the company's strategic planning
Best Practice 1.2 Set closure objectives, including future land use, along with a review of project alternatives
Best Practice 1.3 Consider closure objectives when developing the mining project
Best Practice 1.4 Identify and assess social and environmental impacts of closure when developing the Environmental Impact Assessment for the project
Best Practice 1.5 Develop an acid drainage prevention study and plan as appropriate
Best Practice 1.6 Consider various closure scenarios

Best Practice 1.1

Consider closure planning into the company's strategic planning

It is important to take a strategic view of closure planning, which entails making decisions now that involve future risks. Most companies, however large or small, adopt strategic planning practices. Considering closure planning from a strategic perspective means developing actions and plans aimed at achieving long-term goals, such as a future land use

which is consistent with strategic planning objectives. Also, considering closure in strategic planning means engaging managers at all levels in the organization, especially senior managers with responsibility for decision making, commitment of resources, etc.

Strategic planning is an ongoing process and unfolds into tactical and operational plans, which are defined for each department or unit of a company. As far as closure is concerned, this means first detailing it in successive plans over the years. It also means considering closure in various corporate tactical plans, such as those related to financial, administrative production and human resources planning.

To this end, it is important that all corporate departments be involved. Proper closure needs actions in areas as diverse as finance, accounting, personnel management, procurement, production, environmental management, social responsibility, communications, and even sales. It is therefore far from being the sole responsibility of an environment department within a mining company. Unfortunately, a common mistake is the senior management of a company or the administration of a mine assigning closure planning responsibilities and tasks to the environment department. Such a decision rarely yields good results. It is clear that the corporate division in charge of environmental management has much to say in regard to closure planning – as much as their input is crucial in obtaining licenses and approvals for the opening of a new mine –, but the issues concerning closure of a mine – especially a large mine – require the involvement of all major departments of a mining company.

Various decisions made at different times during the life of a mine should be influenced by the closure objectives, notably long-term mine planning, selection of process technologies and making decisions concerning the location of the project facilities and structures.

A company's strategy also drives its organizational structure and internal processes. Approval of new investments is one of the internal processes of greatest relevance for mine closure planning. Investment

decisions that take into account, among other factors, the legacy to be left – to the host community, the area, future generations, and the company itself – are strategic in nature, and those making them should be fully aware of their consequences.

Designating a person responsible for coordinating closure actions can be an appropriate measure in many companies. This person is tasked with keeping the planning of a mine closure up-to-date by identifying internal or external events that could have an impact on planning. He/she is also expected to inform internal decision-making processes (such as changes in the mining plan and the introduction of technological innovations) with respect to its impact on closure objectives. Another measure for internal integration of the closure planning into business planning is the establishment of an approval and monitoring committee made up of representatives from various divisions of the company. As part of its mandate, it should ensure that decisions on projects explicitly consider the closure objectives.

Manager awareness programs, coupled with initiatives to build staff capacity to work on issues related to mine closure may be needed to disseminate closure planning culture across a company.

Best Practice 1.2

Set closure objectives, including future land use, along with a review of project alternative

It is widely recognized that any plan or project must have its objectives clearly defined, and this obviously applies to planning the closure of a mine. Objectives can be expressed in multiple ways, and a possible distinction is between those potentially applicable to any mine and those customized for an individual mine or even for individual structures of a mine such as a waste rock dump or a tailings dam.

Planning is about setting objectives and the means to achieve them.

A broad closure objective could be presented as "achieving a post-closure situation that represents a positive legacy and brings lasting benefits to the community" that can be maintained without inputs from the company.

To define the objectives to be pursued for planning the closure of a mine, it is useful to draw from a set of principles that reflect the current understanding of the issue. The following three principles may represent the current state of the debate on planning for mine closure, and provide the basis for objectives setting:

1. Protection of environmental quality, public safety and public health.

2. Ensuring reclamation of degraded areas to enable a future land use that is consistent with their capacity and constraints as well as with local and regional demands.

3. Achieving a post-closure situation that brings a positive and lasting legacy for the community.

These principles can guide the establishment of objectives for planning the closure of a mine. The objectives – whether general or specific – define "where to go once closure is complete". Hence, they guide the appropriate actions and measures to be taken at every stage of the life of a mine. As the feasibility studies for a new mine are developed, decisions are made that will influence all subsequent steps that are related to (i) the area under direct responsibility of the company (land ownership, mining lease or right-of-use) and (ii) the surrounding area. The specific objectives refer to actions to be taken regarding the (i) structures and facilities in the area and (ii) the cast of internal and external stakeholders. Table 3 shows the principles and some examples of general objectives of mine closure, which should be broken down into specific goals. These general principles and objectives apply to the majority of situations, whereas the specific objectives should be based on a case-by-case approach – a mine or even a particular structure in a mine. Although the primary responsibility for establishing clear closure objectives falls on the company, it will always be necessary to validate them with stakeholders (Guideline 3).

Table 3: **Principles and examples of closure objectives**

Principles	General Objectives
1. Protection of environmental quality, public safety and public health	Ensure physical stability of the area
2. Ensure reclamation of degraded areas to enable a future land use that is consistent with their capacity and constraints as well as local and regional demands	Achieve the predefined future land use in the area under the direct responsibility of the company (land ownership, mining lease or right-of-use)
3. Achieve a post-closure situation that brings a positive and lasting legacy for the community	Minimize negative socio-economic impacts arising from closure
	Maintain the community's level of economic and social development

In particular, to define a suitable land use once a mining operation has ended, it is important to consider alternative uses for each structure

in the mine and associated areas (pit, tailings dam, waste rock dump, industrial and support areas, etc.), taking into account the capabilities and potential of each one (e.g., buildings that can be reused and areas planted with native vegetation that can play ecological, landscape, and recreational roles), as well as the constraints imposed by these facilities (e.g., a tailings pond). A study of future land use options should consider the costs, benefits, advantages, disadvantages, and risks of each option considered and indicate the preferred option (Best Practice 4.5). The criteria for analysis and selection depend on a number of factors such as legal requirements and corporate policies, among others, and should be clearly described and documented so as to make future revisions easier. In some cases, such revisions will not take place until a few decades later, when the individuals responsible for the primary decisions will no longer be working at the company (as per Best Practice 7.5).

Closure objectives should be as specific as possible. In a conceptual Closure Plan (Best Practice 4.1), the ability to specify closure objectives is limited by the amount of information available and the commitment gained from the community and other stakeholders. As a result, the objectives should be reviewed and updated from time-to-time, from feasibility studies to the implementation phase, as the amount of information typically available for decision making grows rapidly during this project development stage and stakeholders may obtain a better understanding of the project.

In the operational phase, the objectives can be revised (Best Practice 2.4) due to significant changes in the mining plan, changes related to community expectations, new proposals for future land use, and even due to the emergence of new technologies or practices. The alternatives for future use of the area should be proposed and reviewed realistically, reconciled with the objectives of local and regional development and land use policies and with community expectations, captured through structured consultation processes (Best Practice 3.3). Municipal master plans, urban land use regulations and river basin plans, among other planning documents, should be carefully considered.

The importance of setting closure objectives is due to its stark influence on the mining project itself, such as the choice of technological alternatives and the location of the main structures of the project. Alignment of closure objectives with the mining project plays the important role of bringing down the costs of implementing the decommissioning plan, including social and environmental programs, as shown in Best Practice 1.3.

Removing and dismantling buildings and infrastructure used in mining operations shall be reflected in the Closure Plan. However, it is important to assess whether these facilities or part of them may have some productive and sustainable use by the local community or the future land owner. Closure planning should therefore identify and assess the possibility of assigning some facilities and infrastructures to the community. A detailed inventory of these assets and an accurate knowledge of local projects and needs are critical, as well as a proper dialogue with the local government. Closure planning should assess whether it is feasible to maintain such infrastructure in the absence of the company. Examples of facilities and infrastructures that may be of interest to the community include facilities for water catchment, storage, treatment, and distribution; roads; workshops; offices; airfields; recreation facilities; and rehabilitated areas.

Investments by mining companies in environmental compensation and reclamation of degraded areas can be boosted if there are well defined biodiversity conservation goals under a long-term perspective, preferably in partnership with governmental and non governmental organizations. One of the closure objectives may be related to conservation and enhancement of wildlife habitats – e.g., through actions to protect areas important for biodiversity or to enrich natural habitats with native species – whose results shall only be reaped in the long-term and, therefore, require strategic actions and sustained commitments over several years.

Environmental licensing processes for new projects increasingly involve the search for alternatives that seek to achieve net gains in biodiversity

– a step beyond the goal of balancing gains and losses, which is, in turn, more advanced than minimization of losses. Indeed, increasing erosion of biodiversity requires more proactive actions by mining companies, especially the large ones, as they have more resources, but also by small and medium companies, which can play an important role at the local and regional scales.

To learn more:

BBOP, Business and Biodiversity Offsets Programme. 2013. *To No Net Loss and Beyond. An Overview of the Business and Biodiversity Offsets Programme* (BBOP). Forest Trends, Washington.

ICMM, International Council on Mining & Metals. 2008. *Planning for Integrated Mine Closure*: Toolkit. ICCM, London.

Pearman, G. 2009. *101 Things to Do with a Hole in the Ground*. Post-Mining Alliance, Bodelva (UK).

Western Australia. 2011. *Guidelines for Preparing Mine Closure Plans*. Department of Mines and Petroleum, Environmental Protection Authority.

Best Practice 1.3

Consider closure objectives when developing the mining project

Closure of a mine is streamlined when the initial mining project takes into account the need, at the end of the mine's life, to assign the area a new, post-mining use. One implication of this strategic guideline is that choices related to technology and the location of the main structures (especially waste rock dumps and facilities for the disposal of tailings) are made considering the closure objectives – including achieving

the post-mining land use (Best Practice 1.2). This involves planning decommissioning concurrently with planning the implementation and operation stages. Designing the mine with its closure in mind allows its structures to be incorporated as much as possible into the predefined future use, or even help to choose the new use.

Obviously it is not a matter of developing a mine plan solely based on closure needs, but rather considering the end-of-life and the transition to a new use as one of the elements that should influence design decisions. The way this criterion is effectively taken into consideration in corporate decision-making processes makes all the difference since the mining company should have a procedure in place that makes it possible to stop projects that could pose obstacles to fulfillment of closure objectives or could result in extremely high closure costs.

When closure costs and risks are taken into consideration at this stage of development of a project, it is important to have appropriate evaluation criteria in place since most of the costs are likely to be incurred during the last few years of operation and during the decommissioning phase, which means that its present value is likely to be very low.

Therefore, it is not about simply having internal procedures or rules, but it is fundamentally about applying them rigorously across the various successive stages of investment decisions. Projects that do not meet the criteria should be dismissed or reworked so that acceptable alternatives are created. As a result, one can prevent project decisions from jeopardizing or hampering the company's future ability to reduce or eliminate its liability and bequeath lasting benefits.

It is now well established that the choice of the location for the structures of a mine has to take into account the site's environmental baseline study, the legal restrictions and technical characteristics, as well as the geotechnical conditionalities. Many decisions made during project planning that take into account social and environmental characteristics are also conducive of mine closure. However, they may

be insufficient to actually support closure and transition for a suitable land use in the future.

Occurrence of acid generating materials is a particular situation in which closure objectives should guide the project for a new mine, thus helping to reduce future costs and facilitating transition of the area to a new use (see Best Practice 1.5). It is well known that once the acidic solutions generation process is triggered, its discontinuation is extremely difficult, so control actions become necessary for much longer periods of time than the duration of the mine itself. In such cases, segregation of waste rock according to its acid generation potential is the most important project decision that has the greatest impact on the total closure costs of a mine.

Reducing the volume of inert waste rock can also facilitate closure. Its use in civil works in the mine itself (provided they have appropriate technological properties) such as on internal roads, embankments, barriers to minimize noise or visual impact, or reclamation activities at the mine decommissioning phase is a measure that can be considered from the design phase.

On the other hand, minimizing the volume of tailings is a major challenge, not only in terms of mine closure planning, but also of minimizing the environmental impacts of the operation phase. This typically involves materials whose geotechnical properties are unfavorable for various uses. Certain types, however, may be used in civil works or other applications. Fine-grained tailings may have certain industrial uses (such as in the ceramics industry), but it must be recognized that industrial applications require technological research and development that can hardly be conducted prior to the opening of the mine. In underground mines, tailings can be used as backfill in thickened or paste form.

Another issue that can be considered is the possibility of future use of certain facilities for the benefit of the community after operations have ceased, such as facilities for catchment, storage, treatment and

distribution of water, distribution of energy, sheds and buildings, etc. (Best Practice 1.2).

To learn more:

IFC, International Finance Corporation. 2012. *IFC Performance Standards on Environmental and Social Sustainability*. IFC, Washington.

World Bank. 2007. *Environmental, Health and Safety Guidelines for Mining.*

ICMM, International Council on Mining & Metals. 2008. Planning for Integrated Mine Closure: *Toolkit*. ICCM, London.

CASE: TAILINGS FACILITIES IN FORTALEZA DE MINAS

Votorantim Metais's Fortaleza de Minas Unit has been operating a mining and metallurgy site since 1998. The complex has an underground mine, processing plant and pyrometallurgy capabilities. The mine is located in the southwest of the state of Minas Gerais, in the municipality of Fortaleza de Minas. Ni, Cu, Co and Fe polymetallic sulphide ores undergo a flotation process for the production of a concentrate which is currently blended with other concentrates from mines located in the municipalities of Americano do Brasil and Itagibá, feeding a DON metallurgical plant (Direct Outokumpu Nickel) with flash smelting (FSF) followed by casting cleaning in an electric arc furnace (EAF). The hydrogen sulfide produced during oxidation of sulfides in the FSF is converted into sulfuric acid, which then completes the process.

The design of its tailings storage facility was based on the need to streamline its decommissioning and closure. The tailings disposal structure is comprised of a peripheral dike built with clay material with an initial maximum height of 20 m. Unlike a dam, i.e., the damming a watercourse, the tailings deposit in Fortaleza de Minas is a paddock style made up of a polygon-shaped set of dikes built in the middle of a hillside. While a dam retains the runoff from the entire watershed upstream, a hillside

structure only retains precipitation that falls on it. Thus, when the disposal of tailings ceases, the dam is decommissioned and only rainwater needs to be managed.

The soil from the bottom of the reservoir was scarified and compacted as per its executive project. Gravel and sand drains were placed on the compacted layer and, as they cross the dam, the discharge flows are captured at spots located downstream of the dikes, which, in turn, converge to a recirculating water reservoir situated further downstream. As is usual in this type of structure, the dikes were raised in steps during operation and additional drains were installed at each step of elevation.

The actions planned for decommissioning include topographic adjustment of the waste mass (to organize runoff and prevent erosion), use of compacted soil coverage and planting of grass, and obturation of the tulip type spillways.

It is obvious that all best practices recommended for the operation of any tailings dam must also be followed, such as monitoring piezometric levels, conducting regular independent audits, etc.

After decommissioning, the risk of any overflow and internal erosion (which can be important in a tailings dam) will be eliminated since the only stream of water on the structure will be derived from rain that directly falls on the surface itself of the tailings deposit.

Thus, the post-closure phase should run more smoothly, and the necessary actions will possibly be limited to monitoring and minor maintenance services. This perspective derives from decisions made during project design, when the challenges and closure costs were considered as one of the criteria in choosing the preferred alternative.

View of the tailings pond; industrial facilities appear on the foreground.

Aerial view of the tailings pond. Source: Google Earth, 2011.

Source: based on information provided by Votorantim Metais.

Best Practice 1.4

Identify and assess social and environmental impacts of closure when developing the Environmental Impact Assessment for the project

Environmental impact assessment is a universal tool for planning new mining projects and other activities that could significantly alter the quality of the environment. Its primary role is to support decision making – internal corporate decisions on project and investment alternatives and government decisions concerning environmental licensing. Furthermore, impact assessment also plays an important role in the development of environmental management plans by defining mitigation intended to avoid and minimize the adverse impacts of closure, such as social investments, partnerships with development agencies, gradual reclamation of degraded areas, and several others. It also represents an opportunity to establish an effective and lasting dialog with the social stakeholders who will be invited to take part in the mine closure process.

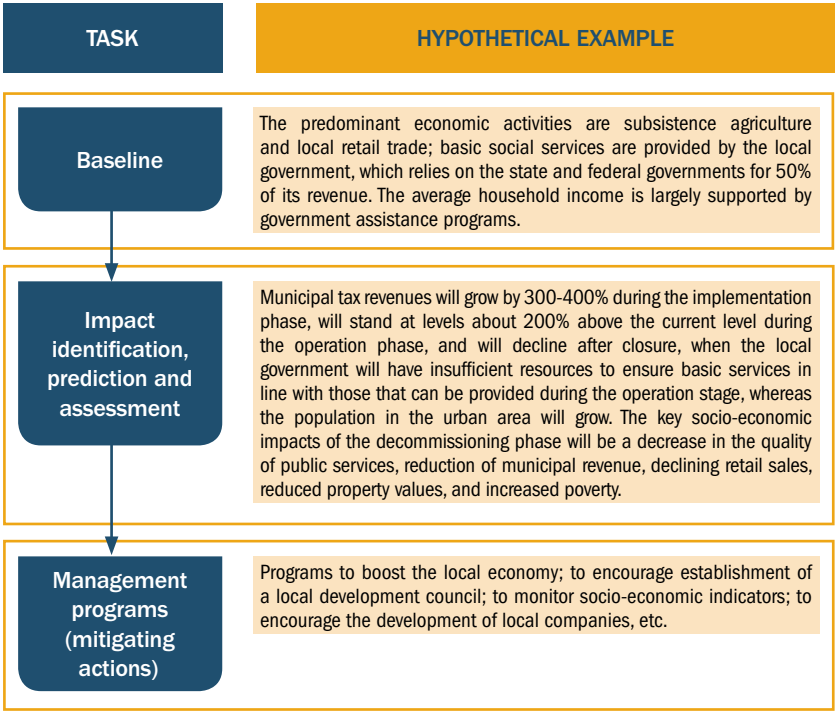
Among the various tasks required for a comprehensive and appropriate assessment of the impacts of a new project, establishing the environmental baseline is of particular interest for closure planning as it can help to: (a) set closure objectives; (b) identify critical environmental issues that must be managed throughout the life of the mine to ensure that the closure objectives are achieved; (c) establish a reference for monitoring environmental indicators upon mine closure; and (d) define benchmarks and targets for management actions to be pursued during the decommissioning and post-closure phases. For example, if a closure objective is "to reclaim the degraded areas with native vegetation," the environmental assessment should include a detailed description of natural vegetation in the area, even if there is no clearing, in order to establish a benchmark for future ecosystem restoration actions. Thus, parameters and indicators to

assess whether this objective has been achieved could also be set for the conceptual closure plan (Best Practice 4.1).

The environmental and social baseline is usually prepared during the mine feasibility study stage, but it becomes more useful if it is revised and updated at the subsequent stages by incorporating the findings of monitoring programs, and reflecting changes in land use and environmental quality that occur in the area of influence of the project, whether these are due to the mine or other sources. Revision and update of the baseline will assist in calibrating the closure objectives established earlier and in defining criteria to assess the extent to which closure objectives have been achieved. A systematic review and update of the baseline should include social and economic indicators that provide information to assess whether the mining operation is in fact contributing to local development.

Identification and assessment of impacts of the decommissioning phase is also a task to be performed during the environmental impact assessment. Particularly in those cases where a municipality is estimated to be highly dependent to the mining activity, the socio-economic impacts of closure could be of great significance, and actions and programs to mitigate them should be put in place. As effectiveness of such actions depends, among other factors, on the duration of the programs, launching them as early as possible could be the key to their success. Figure 5 shows a hypothetical example of such linkages.

Figure 5: Relationship between baseline, impact assessment and management programs



The most common socioeconomic impacts of a mine's closure are:

- lost tax revenues, especially at the municipal level;
- lost jobs and income;
- reduced local economic activity;
- reduced quality and coverage of public services; and
- deteriorated living standards for the local population.

Their magnitude and significance will obviously depend on the economic importance of the mining business in the municipal and regional context.

Closure of a small mine in a town with a diversified economic base may have negligible socio-economic impacts, while closure of a large mine in a small municipality could cause major impacts (Best Practice 6.1).

To learn more:

Australia, EPA (Environmental Protection Agency). 1995. *Environmental Impact Assessment*. Best Practice Environmental Management in Mining. Barton.

Heikkinen, P.M.; Noras, P.; Salminen, R. (org.). 2008. *Mine Closure Handbook*. Geological Survey of Finland, Espoo.

World Bank; IFC, International Finance Corporation. 2002. *It is Not Over When It is Over: Mine Closure Around the World.* Washington.

Best Practice 1.5

Develop an acid drainage prevention study and plan as appropriate

The Acid Mine Drainage (AMD) process is triggered when sulphide minerals come in contact with air and water, thus creating an acidic liquid solution. This has been reported in mines of gold, base metals, coal, and uranium, mainly as a result of weathering waste rock dumps, tailings dams, and ore stockpiles, but can also occur in underground mine galleries, leaching dumps, and open-pit mines. Closing a mine affected by acid drainage is much more challenging and costly than closing mines where this does not occur.

Acid drainage commonly involves high concentrations of solubilized metals, which could pose risks to human health and ecological receptors for long periods of time after mine closure.

Generation, release, transport, and abatement of acid drainage are complex processes that are governed by a combination of biological, physical and chemical factors. To understand these processes, a conceptual model based on the toxicological risk analysis methodology is often required in order to: (i) define the quality and quantity of drainage potentially generated by different sources; (ii) identify runoff and underground acid drainage flows from sources to receptors; (iii) identify receptors that could be affected by exposure to acid drainage; and (iv) define the risk of their exposure.

Developing a conceptual model is key to draw up programs for prediction, prevention and management of acid drainage potentially generated by mining operations. Thus, the conceptual model should be developed during the mine feasibility phase, revised and updated throughout the lifetime of the mine. Preliminary studies cannot do without a well-crafted sampling and laboratory testing program to identify potentially generating materials and those that could potentially mitigate the process, such as carbonate minerals. Such studies are essential for acid drainage prediction and prevention.

For the development of an acid drainage prevention program, a survey of potential sources and main receptors is needed, as well as hydrological, hydrogeological and hydrogeochemical modelling. These should allow for an estimation of the quality and quantity of acid drainage potential generated by a mine.

Preventive actions derive from predictive studies. The main approach to prevent and mitigate acid drainage is to minimize their sources and/or maximize the amount and supply of natural neutralization reagents. This involves: (i) minimization of infiltration and water leaching; (ii) minimization of the oxygen supply through diffusion and advection; (iii) minimization, removal or isolation of sulfide minerals; (iv) increasing the pH of the water in the pores of the aquifer; and (v) maximization of the supply of minerals and groundwater to neutralize acid mine drainage.

Once the acid drainage generation process is established, its discontinuation becomes very difficult and expensive, and may require a combination of active and passive treatment techniques. Active treatment essentially means actions for managing drainage in a similar fashion to effluent management that requires control – for example, through neutralization of pH and precipitation of metal-containing sludge. Passive treatment, on the other hand, holds up regardless of ongoing action by the company, or requires low maintenance efforts. The best known forms of passive treatment are wetlands, which remove metals by providing a reducing environment.

Acid drainage treatment requirements have tremendous financial implications for the closure of a mine. Where active treatment is required, the post-closure stage calls for permanent care by the company (see Chapter 6 for a definition of permanent care) or long term care. In cases where passive actions may be sufficient, programs to be undertaken during the post-closure stage are simpler and may involve a shorter timeframe.

To learn more:

INAP, International Network for Acid Prevention. 2009. *Global Acid Rock Drainage Guide*.

Heikkinen, P.M.; Noras, P.; Salminen, R. (org.). 2008. *Mine Closure Handbook*. Geological Survey of Finland, Espoo. See Chapter 5, Field Studies, Analyses and Modeling in Planning and Monitoring of Mine Closure and Appendix 9, Sulphide Oxidation Process.

Best Practice 1.6

Consider various closure scenarios

All mine planning is based on certain assumptions underlying the project that define the expected life of a mine. It is known that the life of a mine is often extended as a result of investments in mineral exploration, development of new routes for mineral processing and other factors.

However, mines can also close before the planned time, even before the physical exhaustion of the ore body, and this must be taken into account when planning the closure. Three situations – referred to as "scenarios" here – can occur: (1) planned closure; (2) early closure; and (3) care and maintenance, which, in turn, leads to either resumption of operations or early closure.

The so-called planned closure scenario involves exhaustion of the ore, according to a predefined mining plan and in accordance with a Closure Plan. As mines often operate over a much longer timeframe than planned, extensions of planne life should be addressed in revisions and updates of the Closure Plan. However, a mine can shut down production ahead of schedule, leading to early closure.

One must consider, however, that before deciding to implement an early closure, companies tend to suspend production; this scenario is called care and maintenance and requires the company to maintain the mine and facilities on an ongoing basis. If production is not resumed, it is a case of early closure.

Early closure equals the cessation of mineral production activities before the schedule considered in the Closure Plan. As shown in Table 1, suspension of mining operations ahead of schedule can occur due to factors such as falling prices of minerals and metals; changes in the mineral commodity market; operational accidents or incidents; changes

in the corporate policy involving asset sales, mergers, acquisitions, or change in shareholder structure; extreme external events; changes in government policies; problems arising from poor geological knowledge of the mine; and design errors.

It can be observed that some causes for early closure can be controlled by the company (e.g. design errors, geological knowledge of the mine), while others depend on factors beyond its control or influence (e.g. changing commodity prices). Regardless of their control or influence, however, mining companies should be prepared for the event of an early closure since its environmental and socio-economic consequences are at least as important as – and possibly more critical than – those resulting from planned closure.

One approach for the company to prepare for the event of early closure is by drawing up a Contingency Plan (Best Practice 4.3), which describes the actions to be taken to prevent accidents and production stoppages from becoming hurdles to meeting closure objectives.

Care and maintenance, which assumes resumption of the operation, requires appropriate measures, which should also be described in a Contingency Plan. It should be noticed that the objectives to be met when a mine in under care and maintenance are different from planned closure objectives and early closure because, by definition, care and maintenance is not a permanent situation, as the mine is expected to resume operations within a certain timeframe. The length of this timeframe can hardly be defined in advance. In principle, the company would consider the costs and benefits of maintaining the mine under care and maintenance or undertaking closure, but legal, business strategy and other considerations are also of great importance in this decision.

Therefore, the Closure Plan should define actions for each of the three scenarios: planned closure, care and maintenance and early closure. The company can obviously choose to draw up separate plans for each of

the scenarios. In this Guide, the actions under the temporary suspension phase and the possible early closure are described in a Contingency Plan in accordance with the terminology in place in several countries.

A company may decide to sell off its assets – in this case, an inactive mine. For this reason, it is always recommended that the Closure Plan and its financial provisions refer to individual mines, rather than companies.

To learn more:

ANZMEC/MCA, Australian and New Zealand Minerals and Energy Council/Minerals Council of Australia. 2000. *Strategic Framework for Mine Closure*. Canberra.

Sánchez, L.E. 2011. Planejamento para o fechamento prematuro de minas. *REM: Revista Escola de Minas* 64(1): 117-124. Available at http://dx.doi.org/10.1590/S0370-44672011000100016

World Bank. 2007. *Environmental, Health and Safety Guidelines for Mining*.

CASE: VOTORANTIM METAIS'S MANAGEMENT STANDARD CLOSURE SCENARIOS

Votorantim Metais's internal management standards for mine closure establish the need to develop closure plans for: (1) new projects; (2) existing projects; (3) acquisition of projects; and (4) temporary suspension of operations (care and maintenance). According to the company's approach, the closure plan is gradually broken down from the design to the executive level as the planned closure date approaches. Under the care and maintenance scenario, the plan should be adjusted to the new situation, including actions to ensure the area remains stable for the duration of the period.

GUIDELINE 2

MINING COMPANIES SHOULD PLAN FOR THE CLOSURE OF MINES IN OPERATION

For current mining operations there is no opportunity to benefit from planned closure since their original design. However, these mines also cease to operate and this cessation should be planned. Each of the thousands of active mines requires a Closure Plan. Many practices presented under Guideline 1 also apply to planning the closure of mines in operation, but this group has a number of specific issues to be addressed.

In operating mines, the departure points for closure planning are the sum of all interventions already undertaken and the entire history of relationships with stakeholders - the relationships of trust or distrust that were established and renewed along the life of the mine. In addition, managers and planners of mines already in operation may have only an incomplete understanding of the bio-physical and socio-economic environment where they work. Even the knowledge of certain important features of the mine itself that is needed to plan the closure may be insufficient. For example, does existing information on the design and construction methods of a tailings dam allow to draw firm conclusions about its future stability?

For these reasons, setting closure objectives in the case of active mines should be preceded by the preparation of a robust database on the mining project, its history and its environment. Note that the this also applies to mines in a status of care and maintenance. Figure 6 outlines the chain of the main best practices.

Figure 6: Chain of active mine closure planning practices

On the other hand, active mines can undergo an upgrade, expansion or other changes in their production processes or management procedures. Such processes are opportunities to include the mine closure planning in the new strategic planning (Best Practice 1.1). Some of these changes essentially involve internal processes, while others may involve relationships with external players, such as obtaining a new environmental license.

Implementation of this guideline is supported by the following seven practices. Please note that some of the practices outlined under Guideline 1 may also be applicable to mines currently in operation:

Best Practice 2.1 Bring together technical documentation on the mine
Best Practice 2.2 Develop a history of the mine
Best Practice 2.3 Consider mining and industrial heritage when setting closure objectives
Best Practice 2.4 Develop or update an accurate social and environmental baseline
Best Practice 2.5 Assess the risks of existing facilities
Best Practice 2.6 Define closure objectives, including future land use
Best Practice 2.7 Undertake progressive reclamation of degraded areas

Best Practices 2.1, 2.2 and 2.3 correspond to activity "Document and draw up a history of the mine" under Figure 6. Best Practice 2.4 is the actual activity "Develop or update a social and environmental assessment". This group of activities can be performed concurrently or sequentially, but must necessarily precede the risk assessment for existing facilities (Best Practice 2.5) and setting of closure objectives (Best Practice 2.6). Progressive reclamation of degraded areas (Best Practice 2.7) is a recurring recommendation that can be implemented independently from closure planning, but its implementation is made easier if it is integrated into closure planning.

Best Practice 2.1

Bring together technical documentation on the mine

Planning the closure of a mine requires information – which is not always available – on dams, waste rock dumps, and other facilities for which no design documents are available or that may have been built in violation of their technical specifications. Issues regarding stability of these facilities and the need for stabilization actions are critical for closure as one objective of closure is usually to ensure physical stability of the area.

Thus, it may be necessary: (1) to gather technical documentation on the facilities of interest, and (2) to conduct geotechnical surveys.

Typically, the company is expected to have in hand some technical documents concerning its waste rock dumps, dams, pit slopes, and other structures. However, the information available might not be enough to support a reasoned opinion on the stability conditions during the post-closure phase. A preliminary qualitative risk assessment can help determine the need for further work and guide the gathering of additional data, which may require moving to step (2) above, with field

investigations. Small waste dumps may pose little risk, whereas tailings dams (even if small) typically raise concerns that call for attention and may require field investigations.

Original design documents, if any, are extremely valuable to this informed evaluation, but one should consider that sometimes projects are not built in accordance to their design specifications. According to best practices, deviations should be recorded and a final document describing how the project was actually implemented should be prepared – this is called "as built". Unfortunately this is not common practice in the mining industry, even in large corporations, and this was even more unusual in the past.

Other documents that may serve as technical documentation for the purpose of planning the closure of active mines include audit reports (mainly on dam safety, but other safety or environmental audits may contain information of interest) and topographic and geotechnical monitoring records. Interviews with former employees, requesting documents from design companies or even consultating processes with government agencies (primarily in the environmental domain) may yield appropriate techniques for collecting information. Unfortunately, many companies have changed management procedures and in doing so they threw away technical documents that had no evident or immediate use but could be of great importance for planning closure.

Best Practice 2.2

Develop a history of the mine

Recording the history of active mines is one of the first steps to plan for their closure. Establishing a history of land use at the area makes it possible to (i) trace back the main activities of implementation and operation of all facilities in the mine; and (ii) learn about environmental

features and how the area and its surroundings were used, as well as the environmental and socio-cultural resources that should be protected.

Retrieving the history of a mine calls for a multi-disciplinary team to collect and record relevant information on the activities performed in the past and present in the mine area, as well as to document changes in land use occurring in the surrounding area and the socio-economic changes affecting the communities.

The most commonly used procedures for conducting a historical study include:

1. an evaluation and interpretation of photos, aerial images and maps;
2. identifying, finding and reviewing documents relating to the mine;
3. conducting interviews; and
4. reviewing databases and the literature.

If correctly interpreted, old aerial photographs and topographic survey maps may assist in the chronological reconstruction both of interventions associated with the mine (excavation, dumps, buildings) and land use in the surrounding area, thus revealing the progress of urbanization, deforestation or restoration of native vegetation. They also help to identify areas suspected of soil contamination.

Various documents may be of interest when drawing up the history of a mine. They may be documents available in the files of the mining company and those residing in the archives of government organizations, such as environmental protection and mining regulatory agencies. There are quite a few mines that have been in operation for decades and whose technical archives are difficult to consult or even fail to contain important documents. Changes in shareholder control, changes in management or administrative reorganization processes could have led to loss of documentary material that is relevant to the history of a mine.

In such cases, the archives of government organizations may represent not simply an important source, but the only source in this regard.

Interviews play various roles in putting together a history. Older or retired employees, neighbors, public officials, and consultants who provided services to the mining company may assist in identifying key events and documents.

External databases, such as socio-economic statistics or environmental data; government documents, such as environmental quality reports; and literature in general can also assist in the reconstruction of a mine's history. Clearly, in view of closure planning, before starting the survey work it is necessary to be clear about what will be relevant and useful information. As the history is put together, it is important to take into consideration the relevant heritage (Best Practice 2.3).

Drawing up a mine's history also involves uncovering the history of relationships between the company and the community. Successive management changes, changes in shareholder control, and the corresponding corporate policies and other changes throughout the life of a mine may have influenced – either positively or negatively – the company's relationship with the community. The current managers could, for example, be totally ignorant of conflicts that took place when a mine was opened and that could still have consequences for the future operation of the mine.

Therefore, preparing a mine's history should cover the "technical history" and the "social history" components. The information derived from reconstruction of the mine area's history can feed into the setting of closure objectives, which in turn, support the development of subsequent actions to achieve these objectives. In particular, knowing the history of the mine makes possible to identify the capabilities and potential of the area to inform consideration of future land use alternatives. Moreover, a historical review, along with the related Best Practices 2.1, 2.3 and 2.4 assist in:

a. identifying any conflicts that occurred during installation or operation of the mine;
b. identifying environmental liabilities such as contaminated soils, habitat restoration commitments, and damage to historic or archaeological heritage;
c. identifying social liabilities, such as populations that may have been involuntarily displaced by the company;
d. identifying other critical environmental issues that must be managed in the operational phase to ensure closure objectives are achieved;
e. establishing background information and benchmarks for monitoring environmental indicators upon closure of the mine; and
f. establishing benchmarks and targets for environmental management actions to be pursued through the decommissioning and post-closure stages.

Environmental liability assessment is a component of a mine's historical review. Liabilities – i.e., those obligations a natural or legal person must satisfy – can arise from the need to: remediate contaminated soils; stabilize physical processes such as erosion and mass movements; repopulate portions of real estate with native vegetation or establish biological corridors. Social liabilities could also be identified, as in the case of communities that were involuntarily displaced in the past by reason of the implementation or expansion of the mining operation, and for which the resettlement process was not conducted in accordance with currently accepted standards, such as ensuring that resettlement does not result in impoverishment of affected families or communities and that living conditions are better or at least equivalent to those prior to displacement.

To learn more:

Cetesb, Companhia Ambiental do Estado de São Paulo. 2001. *Manual de Gerenciamento de Áreas Contaminadas*. Cetesb, São Paulo, 2a. ed. Available at http://www.cetesb.sp.gov.br/areas-contaminadas/manual-de-gerenciamento-de-areas-contaminadas/7-manual-de-gerenciamento-das–acs

IFC, International Finance Corporation. 2001. *Handbook for Preparing a Resettlement Action Plan*. IFC, Washington, DC.

Sánchez, L.E. 2005. Danos e Passivo Ambiental. In: Philippi Jr., A.; Alves, A.C. (eds.), *Curso Interdisciplinar de Direito Ambiental*. Manole, Barueri, p. 261-293.

CASE: HISTORICAL STUDY OF THE CAJATI PHOSPHATE ROCK MINE

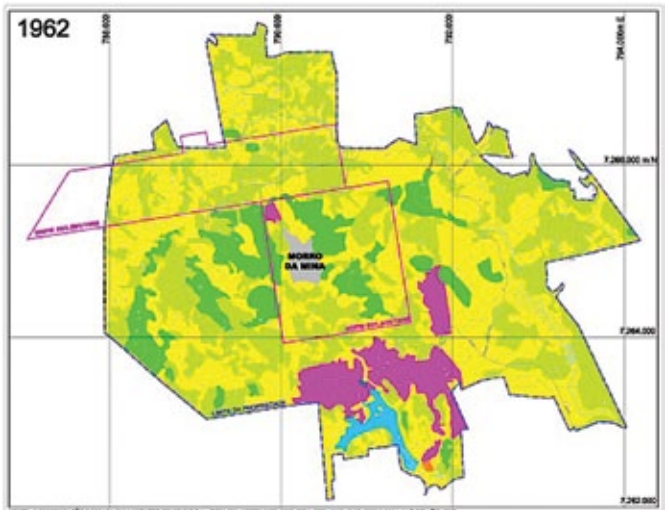
The Cajati phosphate rock mine, located in the southern state of São Paulo, was established in the 1930s, when mineral exploration efforts spotted the apatite deposit at a location called Morro da Mina, known for its magnetite deposits. The mining concession dates back to 1943 and for two decades only the residual ore was extracted. With the advent of the Paulo Abib apatite flotation process, the mine entered a new stage of modern, industrial scale production when the flotation plant started operating in 1970. In 1972, a cement plant became operational, fed by calcite tailings from the apatite concentration process. In the subsequent years, sulfuric acid and phosphoric acid factories became operational, thus laying the foundations for a mineral-oriented industrial complex. The company currently produces dicalcium phosphate as an ingredient for animal feed.

In developing a project for lowering the pit floor, the company conducted a review of the environmental historical of the mining operation, completed in 2009, as part of the environmental impact assessment (EIA) required for obtaining environmental approval. The objectives of the historical review were (1) to identify potentially contaminated areas and areas suspected of contamination; and (2) to carry out a survey of past interventions in the vegetation.

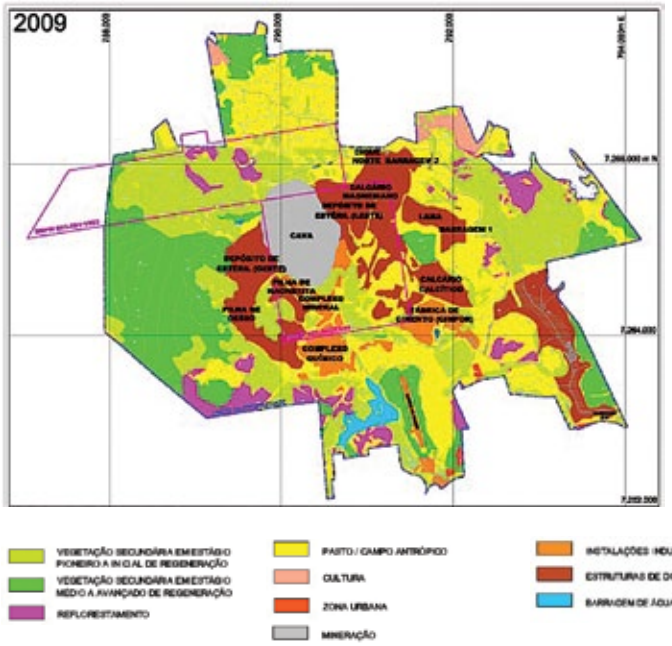
The survey of potential and suspected areas of contamination was performed according to the guidelines for audit and assessment of environmental liabilities internationally known as “phase I”, i.e., involving only desk studies and interviews. According to State regulations, the suspected areas should be investigated (“phase II” review) and, in case contamination is confirmed, these areas undergo remediation and monitoring. Once remediation objectives have been achieved, the area can be released for a new land use. Hence, the environmental liabilities can be reduced – or even eliminated altogether – during the operation of the mine, thus preventing the need for remedi ation actions during the decommissioning stage. Given the usually protracted period of time required for a number of remediation efforts to be completed, early action by the company is likely to reduce the period of active or passive care in the post-closure phase.

The survey of past interventions was based on a multi-temporal comparison of five aerial images taken between 1962 and 2009. Eleven classes of land use were defined in the study area, covering the entire property owned by the company. The areas covered by tailings dams and waste rock dumps were the fastest growing, followed by dedicated industrial facilities and the pit, whereas the greatest percentual reduction occurred in the class of pasture use or anthropic field, which gave way to much of the area covered by dams. The study also revealed an increase in the area covered with native vegetation in middle or advanced stage of regeneration (a classification in terms of local regulations) and a reduction in areas at a pioneer or middle regeneration stage. The study also quantified past suppression of native vegetation in their various stages of regeneration.

The Conceptual Closure Plan was drawn up a few years after the EIA, and could tap into the historical study for the selection of closure objective and development of action plans.



Cajati mine area in 1962.



Mine area in 2009.

Source: Vale Fertilizantes and Environmental Impact Assessment (2009)

Best Practice 2.3

Consider mining and industrial heritage when setting closure objectives

It may be important to conduct a study of mining and industrial heritage when planning for closure of some active mines. Such a heritage can be an asset and help shape the future use of the area. Conservation of heritage may pave the way for a touristical and educational use of an old mine and its facilities. There are several examples of old mines located around the world that have been turned into museums, parks or multi-purpose centers. The expertise of miners and other workers can also be utilized in these projects, which have the potential to generate lasting resources for communities.

Underground or surface excavations, industrial facilities, workshops, housing estates, supporting infrastructures such as power generation plants, and many other components of a mine can be considered for their historic and heritage value. Such components may be located outside the mining lease or the mining company's property, and yet may be of interest for conservation. It is important to point out that a component of mining or industrial heritage may be of interest not necessarily because it is "old", but rather, because it has value for its intrinsic or contextual characteristics.

A mining company may play a catalytic role by reconciling the interests of different constituencies that could benefit from heritage conservation initiatives. In addition, heritage restoration and conservation go a long way to show that mining played an important historical role in the settlement and development of many regions, thus reinforcing its economic and social role from both a historical and contemporary perspective.

CASE: CONSERVATION OF MORRO VELHO MINE'S HISTORICAL HERITAGE

The Morro Velho gold mine was in continuous operation for 170 years. It discontinued operations in 2004. In addition to the abundant studies and documents on it, the undeniable historical value of the deepest and longest operatingmine in Brazil is reflected in its surface facilities and the underground mine itself. The mine is located in Nova Lima, a town adjacent to Belo Horizonte, an area which has been experiencing rapid population and urban growth. The decommissioning plan took into consideration opportunities for heritage conservation and enhancement, alongside social issues – especially the redeployment of workers – and environmental issues, in particular remediation.

In 1994, a Memorial was established by the company. The Memorial is located in the so-called Casa Grande, which was built in the 19th century by the then owner of the mine. The Memorial brings together objects related to mining, such as miners' lanterns, electrical and mechanical equipement, and objects related to social life of the mine. The Memorial is open to visitors. According to the plan for using the old facilities, the area – located in the center of Nova Lima – will undergo an urban renewal process that will include the conservation of heritage buildings.

Dismantling and demolition of facilities involved reuse of materials such as the pine structure that had been used to build the ore treatment facilities. An archaeological excavation discovered artifacts dating back to the 19th century. The project for future use includes urbanization of an area of approximately 20 ha that encompasses the former underground mines and the old ore processing facilities, which have since been demolished. The real estate plan is expected to include residential, commercial and leisure areas. A jewelry production center was considered, as it would establish a link with the gold mining past. A Mine Museum, also designed as part of the future use project, would help preserve the history of the mining operation along with the preservation of heritage buildings.

Other heritage facilities are scattered in the vicinity, in particular the old hydroelectric plants dating back to the early 20th century; one of them was transformed into an environmental education center.

Old hydroelectric plant turned into an environmental education center while the mine was still active.

Historic buildings (in orange) in the industrial area adjacent to the urban area of Nova Lima. The project includes areas for housing, business, retail trade, and leisure purposes, in addition to the Mine Museum.

Source: AngloGold Ashanti Mineração

To learn more:

Pearman, G. 2009. *101 Things to Do with a Hole in the Ground*. Post-Mining Alliance, Bodelva (UK).

Pearson, M.; McGowan, B. 2000. *Mining Heritage Places Assessment Manual*. Australian Council of National Trusts and Australian heritage Commission, Canberra.

Villas-Boas, R.C.; Albuquerque, G.A.S.C. (eds.). 2003. *Patrimonio Geológico y Minero en el Contexto del Cierre de Minas*. CNPq/Cyted, Rio de Janeiro. Available at http://www.cetem.gov.br/publicacao/CTs/CT2003-128-00.pdf

Best Practice 2.4

Develop or update an accurate social and environmental baseline

An accurate baselinefocused on relevant social and environmental issues may provide key information for planning the closure of a mine. In general, environmental assessments are conducted in the early stages of the project as part of impact assessments. In those cases where no such studies are available for mines in operation, they will need to be developed or updated if they have been prepared at the beginning of the project. The environmental and social baseline should be drafted or updated by a multidisciplinary team as it pursues the objective of collecting information that is needed for planning the closure of a mine. For this reason, the baseline should focus on gathering and interpreting **relevant** information.

The environmental baseline required to plan for the closure of an active mine is quite different from the baselines commonly found in environmental impact studies: it should be succinct and describe only the relevant issues. It is often futile for these assessments to contain surveys of primary data such as fauna, flora or water quality. When information on such topics become necessary, it makes more sense to introduce and discuss them in specific studies (Best Practice 7.5). For a Closure Plan, a summary of the relevant aspects in a chapter on the profile of a mine area and its surroundings is usually sufficient (Appendix V).

It is not a matter of developing a comprehensive study of components or processes of the environment in general, but rather to conduct surveys and studies of selected aspects that could be the mainstay of the closure planning, involving the physical, biotic and anthropic environments

From a perspective of mine closure, the socio-environmental baseline should produce data and information for developing future scenarios and understanding the environmental and social processes in the area where the mining operation is located.

The purpose of this baseline is not merely to describe the features of the area. It is primarily used to identify:

1. Issues that require management actions intended for closure;
2. Issues that could heighten the risk of closure objectives not being met; and
3. Knowledge and information gaps that should be filled in order to reduce uncertainties.

Although these three types of issues involve some overlap, articulating them in different ways when preparing the baseline can help identify problems. For example, if the mining plan requires drawdown of an aquifer, the future use of the area could be bound by a flooded pit; in this case, (1) an issue that should be managed during the decommissioning phase will be the pit's fill rate, (2) there may be the risk that the water quality of the pit in the future is inappropriate for certain uses, and (3) possibly the level of hydrogeological, hydrochemical and geotechnical expertise at the moment the baseline is conducted does not allow for addressing these issues in a satisfactory manner, prompting the design of a program to conduct further studies.

In such cases, which are found more often than not when planning for the closure of a mine, undertaking a social and environmental baseline is not a task that would be performed only at a given time. Further detailing certain aspects of the baseline is often required and may reduce uncertainty and support future revisions of the closure plan (Best Practice 7.6).

The assessment also helps in the analysis of the local and regional socio-economic context (Best Practice 6.1). This analysis is recommended for

the company to keep track of its contribution to the development of the local community, and in updating the assessment of environmental and social impacts (Best Practice 7.1).

The distinction between data, information and knowledge (Table 4) helps to understand the role of an environmental baseline. While these concepts are distributed along a continuum, rather than discrete categories, it is generally considered that data correspond to raw signals, which only make sense when interpreted in their context, thus becoming information. In this continuum, knowledge can be defined as the ability to act on and to understand a particular phenomenon or situation.

Table 4: Data, information and knowledge as concepts

Term	Concept	Examples
Data	• Captured symbols and signal readings (recorded and stored) • Objective facts (numbers, symbols, figures) with no context or interpretation • Descriptions of events	• Raw monitoring results • Results of polls • Records of complaints from stakeholders
Information	• Message that contains relevant meaning for a decision or action • Data in context • Meaning or sense of data arising from its interpretation	• Water quality in a particular location and time or period of time • Causes of complaints from stakeholders • Trends in socio-economic indicators for the municipality
Knowledge	• Cognition (know-what) • Ability to act (know-how) • Understanding (know-why, know-where)	• Effectiveness of ecological restoration actions • Seasonal variation in water quality • Company's contribution to improving living standards in the host community

Source: adapted from Sánchez (2012)

Information management and knowledge management are embedded in several Best Practices recommended in this Guide. These are activities that are germane to many functions in a company and of utmost importance for closure planning in view of the long time periods involved, and the inevitable turnover of technical staff and managers. These are some of the reasons that prompt companies to adopt knowledge management practices.

The participation of a multidisciplinary team in the preparation of a social and environmental baseline can generate a lengthy document with various and conflicting perceptions of the environment. This may hinder the quality of the information that will support the decision-making process related to closure. To avoid such an outcome, the team should reconcile the various perceptions of the environment under study by means of appropriate practices (Best Practice 3.3 – Consultation with external and internal stakeholders) with a view to integrating multiple viewpoints.

To learn more:

de Jesus, C.K.C.; Sánchez, L.E. 2013. The long post-closure period of a kaolin mine. REM: *Revista Escola de Minas* 66(3): 363-368. Available at http://www.scielo.br/scielo.php?pid=S0370-44672013000300014&script=sci_arttext

ICMM, International Council on Mining & Metals. 2008. *Planning for Integrated Mine Closure: Toolkit*. See Tool 5: Knowledge Platform Mapping.

Heikkinen, P.M.; Noras, P.; Salminen, R. (eds.). 2008. *Mine Closure Handbook*. Geological Survey of Finland, Espoo.

Best Practice 2.5

Assess the risks of existing facilities

Risk assessment is a tool commonly used to identify hazards and to estimate the (level of) risk – typically understood as a combination of the likelihood of an event and the magnitude of its consequences. Risk is also defined, in a more generic sense, as the effect of uncertainties on the objectives (environmental, health and safety, financial objectives) of an organization.

One of the outputs of a risk assessment is the definition of actions for risk management or treatment. In the case of facilities in a mine, these actions refer to both preventive and emergency actions. The former aim atreducing the likelihood of an event and, therefore, to reduce the risks. The latterare comprised of measures to be taken in case of unwanted events so as to reduce the magnitude of the consequences. Fundamentally, there must be a focus on risk prevention, which is highly relevant to the operation of a mine and also contributes to achieving closure objectives.

In the case of mine closure planning, a risk assessment helps ascertain the present and future risks related to environmental, economic, reputational, and security aspects. Undesired events – such as the release of acidic solutions and the failure of tailings dams, among others – can occur not only during the operation of a mine, but also during the decommissioning or post-closure phases.

There are two kinds of risk assessment aimed at environmental protection, each with a different focus. The first is the assessment of technological risks related to accidents that could have environmental consequences such as disruptions of a geotechnical structure such as a pit slope. The second type is the assessment of risks to human health and ecological risks related to chronic exposure of populations to pollutants.

There are several methodos to implement the first type of risk assessment such as a preliminary hazard analysis (PHA) and a failure mode and effects analysis (FMEA). Choosing the most suitable method should be done by experts with a critical perspective, an unbiased stance regarding the matter, and preferably with some knowledge of the mine and its area. In the particular case of mine closure, this team may include expertise in dam safety, hydrogeology, and water resources management. The following are examples of risks involved in the facilities of a mine:

1. **Open-pit mine:** physical stability (e.g. slopes collapsing for geotechnical reasons, erosion, or land sliding), safety (e.g. strangers entering the area, accidents such as drowning in the pit lake), chemical and biological changes (e.g. poor quality of the water in the pit lake).

2. **Underground mine:** ceiling collapse and poor water quality due to exposure of the ore.

3. **Waste rock dump:** stability of the dump, slopes collapsing, erosion of slopes and covers, interference with groundwater, quality of the effluent from the bottom drain released to surface waters.

4. **Tailings dam:** stability of the dam, dam failure, interference with groundwater, restrictions on future use and fault in the coverage and drainage system.

5. **Industrial area:** generation of industrial waste, radioactive sources, traffic accidents, dismantling and demolition, contamination, and improper future use.

6. **Staff and communities:** legal claims by labor, occupational diseases (e.g. health problems after retrenchment), severance pays (complaints, losses).

The assessment is often conducted from a qualitative perspective, with semantic scale of likelihood (e.g. negligible, very low, low, medium, high, or very high) and consequences (e.g. limited, moderate, high, or extreme), which, when combined, result in assessments of risk levels (for example, scales with three to five levels of risk). This classification system enables the company to prioritize its actions by devoting more attention and more resources to the primary risks.

To support the closure planning process, a risk assessment of existing facilities should use the appropriate time horizon for each closure scenarios – planned closure, early closure or care and maintenance.

The other type of risk assessment deals with chronic risks, i.e., those risks whose consequences can show up in the long run. In some cases of mine closure, it may make sense to consider the human health risks associated with waste and tailings dumps (e.g., leaching of metals and their interaction with the biota). Also, when remediation actions for contaminated areas are required, a risk assessment is recommended for guiding the choice (risk-based corrective action). Remediation projects should typically include a risk assessment which, based on the identification of potential exposure scenarios, helps to define the necessary actions and their objectives.

The ISO 31000 standard states that risk management activities should be traceable, noting that the records provide the basis for improving methods and procedures (see Best Practice 7.5).

CASE: RECLAMATION OF TAILINGS DUMPS IN THE MORRO VELHO MINE

The Morro Velho gold mine was opened in 1834. Various mineral extraction and processing techniques were used. From the 1930s, tailings were dumped in the lower parts of Nova Lima municipality, along the Ribeirão Cardoso. These dumps, known as Galo Novo, Areião do Matadouro, Resende, Fábrica de Balas, Madeiras, and Isolamento, covered about 25 ha, and received some 1 Mm3 of tailings. The dumps underwent rehabilitation and remediation processes from 2004 after the mine's production came to an end. As the town grew, people began to settle in the areas adjacent to the dumps. As a result, the remediation plan had to consider the risks to human health.

The purpose of actions implemented was to contain tailings. One of the dumps, for example, was covered with a PVC membrane, a layer of sand, high-density polyethylene blanket, and 1-meter thick compacted fill, thus enabling a future urbanization of the top portion of the dump. In addition, the slopes were trimmed and covered with layers of sand and clay. Asphalt coating was used on other urbanized areas.

A risk assessment in residential areas revealed that remediation actions should include waterproofing with concrete flooring. Some residents had to have their backyards orchards replaced with a cement cover. Suspended structures were built to allow for the planting of orchards and gardens. In order to minimize nuisances to residents (some 40 families), the company engaged them throughout the process, by close communication and negotiating with the families at each stage of the process and offering collective offsets that mitigated the adverse effects of the remediation actions. As a result of these actions, the Minas Gerais State Environmental Agency issued its "Reclaimed Area for Declared Use" certificate , in accordance with State regulations dealing with contaminated areas. Monitoring of the Ribeirão Cardoso waters, conducted on a daily basis until July 2008, and on a monthly basis since then, showed reduced concentrations of arsenic, the main chemical element of concern.

Galo tailings dump along the Cardoso creeki in 2004, before remediation. The slope was covered with a PVC geomembrane to protect against erosionand to prevent tailings from being carried off.

Galo tailings dump in 2005, after completion of the remediation works. The slope is lined with grass and equipped with rainwater drainage. Thefootpath and a new bridge were requested by residents.

Source: AngloGold Ashanti Mineração and Alves (2010)

To learn more:

Cetesb, Companhia Ambiental do Estado de São Paulo. 2006. *Ações corretivas baseadas em risco (ACBR) aplicadas a áreas contaminadas com hidrocarbonetos derivados de petróleo e outros combustíveis líquidos - procedimento.* Available at http://www.cetesb.sp.gov.br/solo/areas_contaminadas/acbr.pdf

Swart, S.J. et al. 1998. *Environmental risk assessment as the basis for mine closure at Iscor Mining*. The Journal of the South African Institute of Mining and Metallurgy, January/February, p. 1-6.

Best Practice 2.6

Define closure objectives, including future land use

Akin to setting closure objectives in the case of greenfield projects (Best Practice 1.2), for active mines that launch the closure planning process, establishing objectives and the intended future use is the starting point for planning. One difference, of course, is that many facilities will have been installed, so selection of future use should necessarily be based on the current status of the mine.

Best Practices 2.3, 2.4 and 2.5 provide vital information to define closure objectives, alongside same procedures and tools employed to set these objectives for new projects.

CASE: RECLAMATION FOR CLOSURE OF THE FELICÍSSIMO LIMESTONE MINE

Holcim's operations started in 1951 in Iperó, State of São Paulo, the town where the Ipanema and Felicíssimo limestone mines are located. In 1992, the National Forest of Ipanema was created, encompassing the mines. By the end of the 1990s, one of the waste rock dumps (Dump A) started showing signs of instability, which spurred development of an environmental reclamation project intended to integrate the dumps into the forest conservation role. The dump had formed between 1979 and 1982. At its completion, it measured nearly 70 meters in height and stored an approximate volume of 500,000 m^3. It featured a single slope, where erosion and geotechnical instability developed over time. The reclamation project covered seven steps: (1) assessment of initial conditions; (2) topographic surveying; (3) SPT (Standard Penetration Test); (4) dump stability assessment; (5) dump stabilization project; (6) dump revegetation project; and (7) monitoring program. The company estimated that three different factors were crucial for the project to be successful: "investing in the expertise of a specialized consultancy: participating directly throughout the implementation process; and establishing procedures for monitoring and maintenance."

The reclamation of waste dumps was one of the objectives reflected in the Closure Plan approved by the Federal environmental agency IBAMA, with completion in mid 2012. The purpose of the plan was to return the mining areas to the Ipanema Forest. The plan also included other actions such as reclamation of the crushing area, and the construction of a fauna and flora observatory. In 2009, the company finished dismantling all the facilities (e.g. offices, workshop and housing area) and removed the fixed equipment that were still in the area (crushers, transformers, air compressors, etc.). Inert materials that resulted from the demolition activities were removed from the area and taken to licensed landfills. Recyclable material was donated and/or sold. The revegetation stage was completed in February 2011, and since 2010 there has been maintenance of the reforested areas – with new seedlings –, monitoring of fauna and flora, the drainage system, slope stability and water quality of the Ribeirão do Ferro. All stages of the Closure Plan are expected to be completed by mid-2014, when the reclaimed areas will be handed over to ICMBio, the organization in charge of managing the National Forest of Ipanema.

Situation of the waste rock dump A in December 2002.

Situation of the waste rock dump A in March 2012. A pit lake can be seen in the upper part of the photo.

Situation of the primary crushing facilities prior to demolition (2008).

Observatory built in the former primary crushing facilities (2012).

Source: based on documentation supplied by Holcim Brasil S.A.

CASE: DECHARACTERIZATION OF THE TAILINGS DAM AT THE CACHOEIRA MANGANESE MINE

The Cachoeira manganese mine, located in Ritápolis, State of Minas Gerais, was comprised of three open-pit mines and three tailings dams located along the same stream. When production ceased, the mine was owned by Vale, which undertook several reclamation actions, in particular the decharacterization of the tailings dams and the establishment of artificial wetlands.

The term “decharacterization” has been used to describe interventions in tailings dams rendered dysfunctional due to exhaustion of its storage capacity. Involving primarily actions to control runoff water, a structure is deemed to be “decharacterized” as a dam, being transformed into a landform that merges into the local relief. This post-closure use option is in opposition to the classic option of maintaining the dams as functional engineering works, which calls for reinforcing spillways in order to vent the maximum flood with a return period of between one thousand and ten thousand years.

In the case of this mine, the main actions pursued were: to reduce the angles of the slopes that made up the dams (all of which with a low height) from the operating angle of 1V:1.5H to 1V:10H, to obturate the surface spillways so that dams can be completely overtopped (i.e. all the water flows over the structure, which cannot be allowed in active dams for safety reasons), and the formation of a 20-30 cm deep permanent pond, which allows for the planting of vegetation that is adapted to wetland environments.

To ensure physical stability, the project addressed the need to ensure that the water flows slowly over the dam, thus preventing erosion. Although use of the entire crest of the dam for the water flow served this purpose, it was also necessary to carry out hydrological studies to estimate flow rates and water velocities, as well as to simulate erodibility of various coating materials for the downstream slope. As a result, compacted clay was selected for two of the dams, with vegetation coverage (grass and weeds planted evenly to avoid concentration of water flows). The hydrologic design criterion was the average flow rate for a return period of one thousand years.

For the intermediate dam, a different solution was deployed, with a more tilted slope as a slope similar to the others would be too long and would fill half of the retention basin downstream. Thus, a slope of 1V:4H and riprap coating was selected. Flow velocities over the slope were also reviewed to ensure that they would not be higher than those that could move the stone blocks.

The works were conducted in 2009 and the area remains under monitoring.

Aerial view of the dams complex; in light color (center), the intermediate riprap dam can be seen (August 2011).

Overview of the area, with the group of dams and wetlands in dark color, upstream of each dam (August 2011).

Source: based on documentation provided by Vale's Department of Manganese and Alloys and Namba et al. (2010)

Best Practice 2.7

Undertake progressive reclamation of degraded areas

Progressive reclamation means the implementation of actions for the reclamation of degraded areas during the operation of a mine. These may include, but are not limited to, actions such as replacement of the top soil, planting vegetation on slopes and berms of waste rock dumps, and restoration of native vegetation along river banks and other areas.

Progressive reclamation of degraded areas provides several advantages for mine closure. First, it enables the company to gain experience, to generate and store knowledge for use in other reclamation actions, thus making their future reclamation actions more efficient and effective. Moreover, if these actions are accompanied by robust monitoring and the assessment of actual outcomes, they become a powerful outreach tool regarding external stakeholders, which goes to show the company's ability to perform environmental protection and reclamation.This also enhances the credibility of the mining company to perform future actions associated with mine closure.

Degraded areas reclamation programs are essential components of the decommissioning phase of a mining project, but their results are usually only verifiable over the long term, particularly when they involve actions for the restoration of native vegetation or ecological restoration. In such cases, the sooner actions are launched, the better. This demonstrates results and allows the company to gain experience and knowledge.

A degraded area reclamation program should also have a clearly defined objective that is consistent with the objective of future use for the post-closure phase. Thus, reclamation actions should be designed to contribute to the objective of future use, as the intended or envisioned land use has an impact on the type of vegetation to be established and

even the relief – or the topography – in the area by the end of the operation phase.

Reclamation in the mining industry usually involves work that can be classified into four groups: (i) soil management practices; (ii) topographical and geotechnical practices; (iii) water management practices; and (iv) ecological practices.

Soil management practices are related to the protection of soil, a scarce and vital resource. This set of practices includes selective removal of top soil, its storage or immediate reuse, as well as actions to prevent contamination by chemicals and to prevent erosion, among others.

The topographical and geotechnical practices involve recontouring the area affected by mining activities such as waste rock dumps, pit berms, access roads and other components of the mine. The primary purpose of geotechnical practices is to ensure physical stability of the reclaimed areas. Physical stability is considered a requirement, which is not always sufficient, to reclaim a degraded area. The intended future land use will shape other requirements, such as appropriate integration of the area with its surroundings, or the establishment of geomorphological conditions similar to those that the area had before the mining operation. This is called geomorphic or geomorphological approach, in which, beyond physical stability, physical reconstruction of the landscape is sought, thus supporting restoration of flora and fauna communities.

Water management practices aim at conserving the quantity and quality of surface and groundwater. Catchment, transportation and final release of rainwater are fundamental aspects for physical stability of the reclaimed area, as well as for the protection of surface water resources. Conservation of groundwater involves practices related to a drawdown of the level of groundwater and protection of aquifers against contaminants.

Both topographical practices and water management practices also play the role of ensuring chemical stability of the future reclaimed area, thus contributing to prevention of acid mine drainage (Best Practice 1.5). An example is the segregation of potentially acid generating materials and their disposal in a confined location, thus preventing them from coming in contact with water and air.

Ecological practices refer to actions related to management of flora and fauna with a view to establishing plant communities in designated sectors in the mine or its surrounding areas. Again, the intended future land use informs the actions to be taken. The plan for future use of the area may envision a mosaic of vegetation and land use alternatives so that actions to restore plant communities and the associated fauna are specific to each sector of the mine. In addition, the company may become involved in actions carried out in partnership with other players and performed out of their property or concession area, such as riparian reforestation and establishment of ecological corridors connecting patches of native vegetation. These external actions can contribute to the success of reclamation programs within the area under the company's responsibility.

Reclamation practices will not achieve the objectives set in the planning if no control and management actions are geared specifically for this purpose. This is an often overlooked aspect of the reclamation of degraded areas, but it is key to its success, and includes the following requirements:

a. knowledge and consideration of the community's viewpoints;
b. specialized technical guidance for the work to be developed;
c. technical training of the staff involved;
d. systematic development and implementation of operational procedures;
e. provision of resources (human, physical and financial); and
f. monitoring, tracking, recording, and documentation.

For a mining company, beginning the reclamation of degraded areas as soon as practical, along with the active presence of the company during the mine operation phase has the following advantages:

1. reducing the costs of programs to be implemented during the decommissioning phase;
2. reducing the period of monitoring and maintenance activities during the post-closure phase; and
3. demonstrate to stakeholders concrete results of environmental protection and reclamation, thus helping meet the closure objectives.

Reclamation of areas disturbed by its activities is the obligation of every mining company, but some companies take on more ambitious commitments and pursue goals that exceeds these obligations by developing projects to reclaim degraded habitats and restore ecosystem services affected by other players, tieing environmental reclamation actions to their social programs (Best Practice 4.4 and 6.4), or voluntarily adopting biodiversity compensation actions aimed at achieving a net gain. In all these cases, the experience gained from the progressive reclamation can be better utilized if handled from a perspective of knowledge management (Best Practice 2.4); if it is open to innovation (Best Practice 7.4); and the results are incorporated into a management information system (Best Practice 7.5) and used to update cost estimates (Best Practice 5.2).

To learn more:

Australia. EPA (Environmental Protection Agency). 1998. *Landform design for rehabilitation*. Best Practice Environmental Management in Mining. Barton.

Neri, A.C e Sánchez, L. E. *Guia de boas práticas de recuperação ambiental em pedreiras e minas de calcário*. 2012. Brazilian Association of Engineering and Environmental Geology, São Paulo.

CASE: RECLAMATION OF DEGRADED AREAS AT THE ORIXIMINÁ BAUXITE MINE

Several mining companies operating in Brazil have gained extensive experience in the reclamation of degraded areas. One of the pioneers was Mineração Rio do Norte, which established the first large bauxite mine in the Amazon in the late 1970s. The mine is situated in an area covered with dense upland forest. The strip mining method used by the company removes of large areas of woody vegetation, but also allows reclamation actions to be implemented as soon as the extraction of ore in each mining panel is over.

The purpose of reclamation in the mine area is to restore the ecosystem that existed before the mine was opened, or ecological restoration. Early reclamation initiatives with native species date back to 1981, thus affording the company more than thirty years of experience and the potential of careful evaluation of results, which is being conducted through agreements with research institutions.

The experience gained and the scrutiny of evaluation of the results based on a scientific methodology made it possible to test and select a more effective and more efficient procedure, and to derive demonstrable results, and also assist in solving more complex problems related to reclamation of the tailings ponds, which, since the mid-1980s, are built in depleted mining panels.

Source: Salomão, Rosa e Morais (2007)

GUIDELINE 3

CLOSURE PLANNING SHOULD ENGAGE BOTH EXTERNAL AND INTERNAL STAKEHOLDERS

Stakeholder engagement is a process that should be initiated as early as the feasibility study stage for the project and continue throughout all stages of the life cycle of a mine. In those cases where the engagement process has not existed since the implementation and deployment stages, it is recommended that it be set up as early as possible by means of a predefined plan.

The strategies and efforts that should be deployed in this process vary according to the nature, location and size of the project, as well as the stages of its life cycle. An effective process of stakeholder engagement enhances relationships with the directly affected community, as well as other social groups. This relationship can significantly help improve mine closure planning, including for objective setting.

The literature provides a wealth of methodologies and tools to promote engagement and society's participation in the process of developing a project. The selection of the method and tools should take into account the project's context and the profile of the audience to be engaged. Methods that yield good results in a given context may not be as effective in other contexts. Cultural and sociability issues, schooling, income level, and other factors should always be taken into consideration. However, the engagement of internal and external stakeholders comprises an array of activities and interactions that should include: (i) identification and analysis of stakeholders; (ii) disclosure of information on the project; (iii) consultation with stakeholders; (iv) negotiation and establishment of partnerships; (v) conflict management; (vi) involvement in monitoring actions; and (vii) accountability reporting. For every step in the life cycle of a project, these actions should be reviewed, fine-tuned and reoriented,

considering the various environmental and social opportunities and risks as they emerge.

In order to plan for the closure of a mine, stakeholder engagement, whether stakeholders belong to the external community, whether they belong to the internal community of workers and employees, should cover the following practices:

Best Practice 3.1 Identify both external and internal stakeholders
Best Practice 3.2 Share information on the closure process
Best Practice 3.3 Consult with external and internal stakeholders
Best Practice 3.4 Establish a mechanism for the submission of complaints and managing conflicts
Best Practice 3.5 Engage stakeholders in the post-closure monitoring stage

Figure 7 illustrates the sequence of Best Practices 3.1 to 3.3, and the main uses of their findings in order to inform the definition of future use (Best Practice 1.2) and closure scenarios (Best Practice 1.6), all practices related to preparation of a Closure Plan (Guideline 4), cost estimation and financial provision (Best Practices 5.1 and 5.3). Best Practices 3.4 and 3.5 assist mainly in the implementation of Guidelines 6 and 7.

Figure 7: Chain of stakeholders engagement practices

Best Practice 3.1

Identify both external and internal stakeholders

For any organization, it is important to know the individuals or groups who could be either directly or indirectly affected (either positively or negatively) by a project and those who may have an interest or influence on its results. Identification or mapping and analysis of these stakeholders have been used by many companies to support decision-making in key moments, such as planning a new investment and preparing for closure.

Stakeholders identification is a dynamic process; there are individuals and groups who converge and diverge, show interest or disinterest depending on the various stages of development of a project and their implications. Thus, the identification of stakeholders, in addition

to being detailed and exhaustive, should be periodically updated. It is often recommended that the update be conducted once a year or whenever a major change or modification occurs in the project, social conditions, social programs and projects undertaken by the company, and as preparation for a detailed project decommissioning step.

At this stage, the potentially affected groups or individuals may be different from those identified in the early stages of the project or during its operation. Concerns and interests may also vary, with consideration of the impacts of mine closure, such as lost jobs, declining economic activity, etc. Ideally, these concerns should be considered as early as in the initial stages of the project. Information collected and reviewed as part of environmental and social impact assessment contribute significantly to this identification process (see Best Practice 1.4).

Updating the map or matrix of stakeholders is a prerequisite for mine closure planning. If the identification of stakeholders has not been a practice pursued by the company, a mapping of groups or individuals potentially affected by the closure of the mine should be conducted as a minimum.

Stakeholders include all individuals or groups who might be affected by the project, or have an interest or influence on its results. They include local communities, representatives from local and regional officials, civil society organizations, political and religious leaders, trade representations, vulnerable social groups, suppliers, customers, employees, contractors, etc. The mine closure stage poses risks and opportunities of a different nature compared to other stages of the life cycle of a mine. Thus, a new set of stakeholders could emerge, including landowners in the vicinity of the project, local officials, development agencies, and local and regional suppliers. Appendix I provides a reference list for identifying stakeholders.

The impacts of closure may differfor each group, while affecting most significantly those most vulnerable.

Within the company, employees and contractors, as well as local and regional suppliers, should be carefully considered, in addition to the suppliers of contractors or subcontractors. Identifying these stakeholders should take into account other jobs that may be lost once the mine is closed, including those generated by investments in social programs and projects at the community level or those generated in the local retail and service trade as a result of purchases and acquisitions made by employees and contractors of the mining company

IDENTIFYING RELEVANT STAKEHOLDERS FOR MINE CLOSURE PLANNING

Mine closure can cause new risks and opportunities. Hence, the relevant and potentially affected groups or individuals may be different from those identified in the early stages of the project. In addition to being detailed and comprehensive, identification of stakeholders should be updated from time-to-time. It is important to distinguish those groups or individuals who will be directly affected by closure from those affected indirectly.

Some key questions that may help to indicate how and to what extent groups or individuals will be affected include:

- Who will be adversely affected when the mine is closed?
- Which groups are the most vulnerable to mine closure?
- What is the scope of the impacts associated with the closure (local, regional)?
- Which groups or individuals could help to support the

closure objectives (local governments, development agencies, landowners, tenants, nearby communities, etc.)?

- Who are the beneficiaries of the company's social programs currently in place?
- Which organizations represent workers (councils, trade unions, professional associations)?
- Who are the company's direct and indirect suppliers?

To learn morre:

Anglo American. 2012. *Socio-Economic Assessment Toolbox Version 3*. See Tool 2B: Developing a Stakeholder Engagement Plan.

ICMM, International Council on Mining & Metals. 2013. *The mining sector in Brazil: building institutions for sustainable development*. ICMM, IBRAM-Instituto Brasileiro de Mineração, London.

IFC, International Finance Corporation. 2007. *Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*. IFC, Washington.

Instituto Votorantim. 2012. *Manual de engajamento de partes interessadas*. Instituto Votorantim.

http://commdev.org. This website is a repository of information, public documents, tools, case studies, guides, best practice examples and studies produced by IFC and other organizations to guide the actions of companies with a view to engaging the affected communities and promoting local development.

Best Practice 3.2

Share information on the closure process

Although the company should engage in communication practices from the early stages of a project, a good communications plan is particularly important at key points in the life cycle of a mine, such as early in its implementation and as it approaches its closure. Accessible, transparent and up-to-date information on the project is the key to a successful participatory approach adopted by the company. Information on the project, its social and environmental impacts and on any changes and their implications should feed into participation processes, public consultation, mediation, and negotiation of any conflicts.

Assessing whether the project is actually contributing to strengthening the local economy and whether the social and environmental actions and programs in place are achieving the desired results is as important as the dissemination of these results to the affected community. Access to this information, which should also be available to the local government, contributes to strengthening the participation of residents in the search for solutions to conflicts or to tailor the actions and objectives of the programs in place, or to propose alternative actions, including in mine closure planning.

Indicators are an excellent tool for mass communication, since they can anticipate and reveal trends, in addition to forecasting adverse economic and social events. They can also help to make actions more transparent and to boost willingness to engage in truly collaborative work.

Communication should aim to provide relevant information which enables the participation of stakeholders at appropriate steps of closure planning. Information should be transparent, straightforward, current, in a language that is accessible to the public it is intended, and take into consideration the diversity of interests of various groups and individuals who might be affected by the project and its closure (Appendix II).

This means that the format and channels to disseminate information should take into account: the diversity of the audience, such as its ethnic and gender composition; the appropriate use technical terms; the level of education of the audience; thelocal leadership structures; the level of association activism, etc. Employees – whether at operational, technical and managerial level – as well as contractors and the supply chain also have to be considered as target audiences of the company's communication programs.

Planning the closure of a mine should involve a specific communications plan that anticipates potential social and economic consequences that are relevant to certain groups or individuals, and the actions to be implemented to mitigate adverse effects. The sooner the information about the closure is disseminated to the community in general and workers in particular, the greater the possibility to pursue alternative actions to minimize lost jobs and the negative impacts on the local economy.

"Communication noise" may sometimes interfere with reception of a message. Between the sender and recipient of a message there are "filters" that can change the way the message will be interpreted by the recipient, who may also be receiving other messages – conflicting at times– coming from other senders, such as other stakeholders. It is important that the company implement policies and procedures that minimize noise which, in case of mine closure, could be amplified. Indeed, there is a recurring concern that the term "mine closure" could frighten the local population and the employees, thus causing distrust or concern about lost jobs and damage to the local economy. A frequently asked question is when and how to communicate news respecting the closure of a mine, considering that its life is often estimated in intervals of decades. Communicating the closure of a mine requires early, clear and consistent information in order to reduce any noise.

It is extremely important that information on mine closure clarifies the time horizon in which this event will occur. Ideally, stakeholders, employees and contractors, the community and the local government should be informed many years prior to the date scheduled for the closure of the mine, which will make it easier to understand that closure will not be a short-term event. On the other hand, one must consider other possible scenarios – early closure and care and maintenance, as discussed in Practice 1.6. In all cases, ensuring that the information reaches stakeholders is imperative in order to uphold the company's credibility and collaboration in the mine closure process.

Ensuring access to information entails making use of different media and tools, such as meetings with specific groups from affected communities; meetings with small groups, which might express specific interests and concerns; meetings with community leaders, press, electronic media, or other local media.

Some information is particularly strategic, such as communication on the termination of jobs or the layoff of a significant number of employees, the criteria for dismissal, the possibility of finding a new job at local or regional level, and sometimes the transfer of employees to other mines. This information should be timely and included in a retrenchment program to be developed and implemented by the company.

In this case, closure planning should consider specific means of communication to different audiences, such as the company's employees, suppliers in the supply chain, the local government, and the community itself. Resignation schedules, alternative jobs for workers or transfer to other corporate units, and diversification of the economic base are issues that addressed in this communication process.

The local government and development agencies that operate in the area should be notified in advance in a transparent and consistent fashion, based on information associated with a corporate action plan. Social and economic changes and impacts arising from mine closure should

be reported so that the government can take the future post-mining scenario into consideration in its strategic planning and policy-making.

According to the potential social and economic impacts arising out of the closure of a mine and the degree of economic dependence of the community, an ongoing dialogue and information flow will need to be established with a focus mainly on compensation, new job opportunities, reclamation of degraded areas, relinquishment, new land uses to be pursued, and new opportunities for the local and regional economy, as appropriate. Information on closure should be reported well in advance of actual closure in order to create the necessary conditions for the transition from a state of dependency to the new post-mining economic context.

APPROPRIATE COMMUNICATION FOR EVERY STAGE IN THE LIFE OF A MINE

The content and the communication channels should be appropriate for each stage of the mine's life. During the feasibility study stage (Figure 2), information on closure can be embedded into the environmental impact assessment and its public consultation process (Best Practice 1.4). During the operational stage, communication on closure should be associated with the schedule for the decommissioning and environmental reclamation programs (Best Practice 4.2), social programs (Best Practice 4.4), and implementation of community development programs (Best Practice 6.4).

Communication efforts will be more intense as the planned closure date approaches, and extends into the decommissioning stage, in parallel to the implementation of programs and the assessment of their results.

To learn more:

IFC, International Finan ce Corporation. 2007. *Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*. IFC, Washington.

Best Practice 3.3

Consult with external and internal stakeholders

The basis of a stakeholder consultation process is access to relevant and high quality information about the project and its impacts. Therefore, this practice is closely linked to the actions in the communication plan. As the process of consulting with the community and other direct or indirect stakeholders in the project begins in the early stages of a mine's life cycle and becomes constant over time, it will be easier to include this practice in the closure planning.

In mine closure planning, consultations with stakeholders should have the following strategic objectives:

- enhance their knowledge and understanding of the project and the impact of its closure;
- share expectations, concerns and perceptions of the future situation of the area after closure;
- help to establish a cooperative and collaborative environment with a view to achieving a satisfactory economic and social situation in the post-closure phase; and
- create a shared understanding of issues pertaining to closure, seeking to reconcile various points of view between the community and the company and within the company itself.

Consultation assumes a dialogue between the parties. For this dialogue to be established, mine closure planning should be an opportunity to reach a good understanding of the project, its post-operation impacts, mitigation programs, and future scenarios. Consultation also makes it possible to know the different points of view, interests and expectations of the community and other groups and individuals involved, which will be extremely useful to the mine closure plan and its objectives.

A consultation process should be conducted to make sure the various points of view of the interested and affected parties can be expressed. This process should be informative in a straightforward and transparent manner, the language should be appropriate to the cultural context and information should encompass risks, social and environmental impacts and opportunities arising from mine closure.

The consultation process should be well organized and interactive, so that the concerns and issues that might be expressed can be considered in the company's decision-making process regarding mine closure. It is important that the company's management follow this process. The team responsible for stakeholder consultation needs to have access to the same information and convey a clear and consistent message. One should be careful not to make commitments that cannot be met in the post-closure phase.

In addition, the stakeholder consultation can be an opportunity for social learning, i.e., a process in which the well informed stakeholders can build a critical, creative and collaborative knowledge base. This is critical in locations that are heavily dependent on the mining industry, such that it is necessary to look for business alternatives to diversify the local or regional economy.

Preparation of a detailed plan before initiating consultations is highly recommended. The plan can be designed for different audiences, with

interests and concerns geared towards various issues, from lost jobs and decreased tax revenues, to actions for monitoring tailings dams, revegetation plans, etc. The consultation may involve one-to-one or group interviews,, workshops, work meetings, discussion forums, public hearings, surveys, and polls (Appendix III).

It is important that the company show stakeholders how it mainstreamed any changes into its plans as a consequence of demands or suggestions put forward during the consultation process, after review and consideration by the company's decision-making levels. The communication channels to provide feedback to stakeholders may vary, and includes reports, new meetings or other appropriate means to reach out to the stakeholders.

Regarding manpower, it is recommended that the process be followed by a group or committee consisting of representatives from workers and suppliers, established prior to the decommissioning, i.e. before production ceases. By developing and implementing a resignation or new application plan in accordance with the requirements imposed by applicable labor regulations, the company should take into account the local and regional socioeconomic context, in particular the degree of dependence of the local economy to the mining business (Best Practice 6.1) This information is important to support an evaluation of the economic impact of lost jobs (Best Practice 7.1). Furthermore, to assess the magnitude of the layoffs resulting from closure it is necessary to know the profile of workers with a job (qualifications, gender, type of employment) and the affected production chain. Some additional compensation actions may be included in the resignation plan, such as training programs or temporary economic assistance to the families of workers laid off in a situation of social vulnerability (Best Practice 4.4). Appendix IV provides a list of the main issues that should be considered when drawing up a resignation plan.

To learn morer:

Anglo American. 2012. *Socio-Economic Assessment Toolbox Version 3.* See Tool 2B: Developing a Stakeholder Engagement Plan.

IFC, International Finance Corporation. 2005. *Managing Retrenchment*. Good Practice Note 4: 1-24.

IFC, International Finance Corporation. 2012. *IFC Performance Standards on Environmental and Social Sustainability*. IFC, Washington.

Best Practice 3.4

Establish a mechanism for the submission of complaints and managing conflicts

In planning the closure of a mine, the company should prepare to handle new types of conflicts that may arise as a result of mine closure. A conflict can emerge at any stage of the life of a mine. Rather than trying to avoid it, which would be unrealistic, one should recognize it and find ways to manage it. However, some concerns that are the source of potential conflicts associated with closure may be very specific issues, such as lost jobs, perception by the community that commitments made by the company are not being met or are being met partially or inadequately, just like the fulfilment of environmental obligations, as well as fears of how the future owners of the area may interact with the local community.

In the decommissioning stage of a mine, a very frequent concern by the community and governmental agencies has to do with the

company's ability to manage environmental programs and monitoring actions during the post-closure phase of the project. As an example, if the community's water supply comes from facilities deployed by the company, there may be concerns about the continuity of service. Likewise, in the case of maintenance of facilities representing residual risk, such as a tailings dam, the company's presence and an effective channel of communication are important actions that send a signal to the stakeholders that the company is committed to the safety of the community.

A formal mechanism for the submission and recording of complaints and grievances should be implemented and maintained by the company from the early stages of project implementation, and facilitate resolution of conflicts over the life of the mine. As closure approaches, having this mechanism in place is no less important. This mechanism should be widely known and readily accessible to stakeholders. The format may vary according to the scale and level of social and environmental impacts and risks posed by the project. Options include a channel for direct communication, via a toll-free telephone line, an ombudsman service, a website maintained by the company, regular meetings with specific community or citizens advisory groups, establishment of an office to receive and forward complaints and grievances, or even ensuring the presence of an officer specially designated for dialoguing with the community.

Likewise, mine closure planning should include a similar mechanism for labor issues, with a record of complaints and grievances related to the workplace that is easily accessible to employees, who should be informed of its availability. The complaints and concerns should be forwarded to the line managers for corrective action, as appropriate, and notified to stakeholders upon completion. This procedure by no means overrides legally established labor complaint mechanisms.

To learn more:

IFC, International Finance Corporation. 2012. Guidance Note 1. *Assessment and Management of Environmental and Social Risks and Impacts*. IFC, Washington.

http://commdev.org. This website is a repository of information, public documents, tools, case studies, guides, best practice examples and studies produced by IFC and other organizations to guide the actions of companies with a view to engaging the affected communities and and promoting local development.

Best Practice 3.5

Engage stakeholders in the post-closure monitoring stage

A mining company may remain liable for developing and managing some sort of post-closure environmental and social monitoring on-site. Planning for mine closure should ascertain whether these future management systems will be able to keep up the stakeholder engagement process. The engagement and participation of stakeholders in monitoring mitigation and socio-environmental programs especially designed for the post-closure phase help to make this process more transparent, facilitate the allocation of responsibilities and could be conducive of a community empowerment process so that it may exert influence and has capacity to act and make decisions on the issues that directly affect them.

In the closure planning process, the objectives and issues to be monitored with the participation of stakeholders should be clearly defined, as well as the means to store and disseminate data and information generated throughout this process. When monitoring objectives are clearly defined, it becomes easier to establish which indicators may be used as a tool to monitor and evaluate the actions performed.

It is important to identify and assess the capacity of community leaders and local institutions to participate actively in following up the situation in the area in the post-closure phase.

There are cases where the local community has little capacity to participate effectively in monitoring processes. In such cases, closure planning should consider implementation of programs geared towards the development of certain skills and capacities so that local community members or non government organizations (NGOs) operating in the area can participate in the monitoring process, notably with regard to the implementation of new land uses after relinquishment.

It is also possible, in particularly complex cases, to set up a monitoring committee with the participation of other stakeholders, local government, representatives from professional councils, academia, who are tasked with preparing reports and communications containing relevant information on the aspects monitored.

The post-closure care by the company can sometimes span a long period of time. Depending on the characteristics and impacts arising from closure, this period may be longer than the life of the mine. During this period, the objectives, targets and results should be regularly reviewed and revised where necessary.

CASE: POST-CLOSURE ACTIONS AT MINERAÇÃO MANATI AND THE COMPANY'S PRESENCE

The Cabaçal gold mine (located in the state of Mato Grosso) operated from 1987 to 1991. A total of about 1 million tons of ore (run of mine) with an average grade of 5 g Au/t was extracted from a 200m-deep underground mine. The surface facilities included a processing plant, foundry, waste dump, tailings dams, and water dam. The sulphide ore was a source of acid drainage.

It was owned by Rio Tinto, and the closure actions included reclamation of degraded areas, removal of all industrial and supporting installations, support to staff (there were 280 employees as of the close of production) and to the community, and a program for long-term post-closure care.

Although the company obtained from the State environmental authority a decommissioning certificate in November 1992, its presence in the area on an ongoing basis was fundamental to solve a problem that occurred after relinquishment to an agricultural company.

The closure objective was to reclaim the area for agricultural use, which prompted actions for: (i) re-contouring reclaimed land to blend them with the adjacent natural landscape; (ii) controlling the effects of potential rock acid drainage; (iii) ensuring water quality complies with legal requirements; and (iv) securing a maintenance free and stable rehabilitated area.

Access to underground excavations was filled with demolition waste from the surface facilities. Grass for use as pasture was planted in the tailings pond and a peripheral canal diverted run-off water. The workers were given the choice of being transferred to an alternative unit of the company. The main component of post-closure actions was monitoring water quality, but they covered other aspects, such as conducting visual inspections throughout the area.

However, an inspection in 2001 revealed that the new owner had introduced changes that were inconsistent with long-term stability of the area – a reservoir was built on the tailings pond. The mining company had been careful enough to include in the property sale contract provisions requiring free access for environmental monitoring purposes, and imposed certain restrictions on activities and interventions in the area. Thus, the reservoir was undone while the company continued its monitoring programs.

This case illustrates many of the problems that need to be addressed when closing a mine, particularly in the post-closure phase.

Formerly a tailings dam, the mine area now is used for agriculture, although some restrictions apply.

Warning sign on restrictions on area use after relinquishment.

Source: based on papers presented at the "Mine Closure" seminar sponsored by IBRAM in 2008, at ExposIBRAM Amazônia, 2010, and an interview.

To learn more:

IFC, International Finance Corporation. 2007. *Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*.

ICMM, International Council on Mining & Metals. 2008. *Planning for Integrated Mine Closure: Toolkit*. London.

GUIDELINE 4

THE RESULTS OF PLANNING SHOULD BE CAPTURED IN CLOSURE PLANS AND OTHER RELATED DOCUMENTS

The Closure Plan is a document that consolidates and summarizes the strategy and vision of a company on the closure of a mine. It is also expected to provide a sufficiently detailed description of the actions or programs to be implemented in order to achieve the closure objectives.

A misconception prevails that the purpose of closure planning is to develop a document called Closure Plan. The plan is simply a means, not an end. It is a document, a reference with a timestamp that brings together the intentions and commitments of the mining company regarding the needs and challenges arising from the inevitability of mine-closure.

Recording information makes it possible to take advantage of and reuse the experience from past projects in order to avoid repeating mistakes, improve information sharing across the company, and enhance individual and organizational learning. In addition, keeping records avoids loss of intellectual capital when the individual in charge of closure planning leaves the company or changes positions.

But the Closure Plan is not the only document that keeps track of information on or of interest to closure planning, which can also be captured in other documents and databases. Information and knowledge obviously reside primarily in the individuals who are members of an organization, but turnover and the long life of many mines make their storage in documents a requirement.

The following practices help to implement this guideline:

Best Practice 4.1 Document results of planning in a Closure Plan
Best Practice 4.2 Develop decommissioning and reclamation programs
Best Practice 4.3 Prepare a Contingency Plan
Best Practice 4.4 Develop social programs
Best Practice 4.5 Assess and manage risks involved in the closure actions and programs

Best Practice 4.1

Document results of planning in a Closure Plan

The Closure Plan documents the findings of the planning process. It is a record of the company's commitments with the stakeholders. This plan contains key information and guidance for the company to implement closure actions.

There is widespread consensus on the need for a Closure Plan to feature increasing levels of detail as mining production progresses. Although terminology varies across companies and in the literature, major areas of agreement are: (1) before opening a mine, a conceptual closure plan should be developed; (2) for active mines for which no closure plan was prepared since its inception, a basic plan should be drafted as soon as possible; (3) during the operation stage, successive plans are prepared with an increasing level of detail; and (4) a few years before the scheduled date for cessation of production, a detailed plan should be drawn up.

The prevailing practice is based on the following assumptions:

Conceptual plan: A closure concept is developed alongside the preparation all other project documents. It usually outlines a closure strategy and may include a review of alternatives for future use or be preceded by such a studyA closure strategy provides general guidelines that direct the selection of closure objectives or even sets such objectives (Best Practices 1.2 and 2.6). A review of alternatives helps to define or refine these objectives. The plan should introduce the expected concept for closure, indicating, for instance, the need for active care and potential restrictions for future use. In many cases the conceptual plan is available to the public and is part of the requirements for environmental licensing.

Basic plan: A preliminary version of this plan may be equivalent to a revision and update of the conceptual plan after implementation of a new mine and its full operation. Since actual projects may deviate from the original design, these plans document the changes and record the necessary adjustments. As for mines in operation, a Basic Closure Plan can be drawn up after thematic studies have collected and reviewed relevant information. For example, an issue that can involve significant uncertainty has to do with the behavior of the aquifer once drawdown ceases. Because understanding of this issue is often crucial to the closure plan, a basic project can be developed and revised as knowledge on this topic progresses. Successive revisions of the Basic Plan should reflect the internal and external changes vis-à-vis the mine (Guidelines 6 and 7), whereas, during its term, a Basic Plan may be useful for the company to evaluate to what extent other initiatives (e.g. changes in waste rock disposal) are consistent with closure objectives. A major element in a Basic Plan is the Contingency Plan, which describes actions to be undertaken in s of care and maintenance or early closure.

Detailed plan: This plan is prepared once the likely date of production cessation is known with a reasonable degree of certainty, and this is recommended to be at least five years in advance. The Detailed Plan describes all programs to be adopted, including

allocation of responsibilities and ideally identifying indicators to assess the performance of each program. The following are the main components of a detailed plan: (a) Decommissioning and reclamation plan; (b) Monitoring and follow-up plan; (c) Social programs, which are described in the other Best Practices under this Guideline. The cost estimate in a detailed plan should have a higher level of detail and accuracy.

Appendix V provides a description of the possible contents of a Closure Plan.

The Closure Plan documents the commitments undertaken by the company. The greatest care should be taken to ensure an organized, systematic and objective presentation of these commitments (usually in the form of programs). Commitments described with ambiguous language could lead to internal and external stakeholders having different interpretations of the intentions of those who undertook the commitments.

A Closure Plan is only useful as an internal document to a company as it actually embodies the commitment of senior management. Appointment of an approval and monitoring committee involving representatives from relevant divisions of the company can be a way of disseminating the closure plan internally. Approval from senior management is indispensable.

A Closure Plan for internal use in a company will be a purely administrative document if it only describes the actions to be taken. Although this is also one of its purposes, its main usefulness is to

document the analysis performed by the team involved in closure planning. For this purpose, it should identify: (1) the issues that need to be managed so that closure objectives are achieved; and (2) issues that could increase the risk of undesirable closure outcomes. For example, if a company does not have an appropriate procedure for dam safety in place, this should be documented in the Plan as an issue that might prevent closure objectives from being achieved. In a proposed contents for a Closure Plan, these issues could be explained as early as in Chapter 1 (Definition of the key issues and objectives of closure).

In the Plan revisions, these issues should have been addressed in a satisfactory manner and progress in dealing with these issues can also be recorded in the revised plan. Another example: if the company is faced with liabilities that could be dealt with during operation (such as hydrocarbon contaminated areas) and fails to address them, it could be passing on costs to the decommissioning phase that could be allocated to production, thus increasing the estimated collateral.

CASE: VOTORANTIM METAIS'S MANAGEMENT STANDARD FOR CLOSURE PLANS

Since 2006, Votorantim Metais has had internal guidelines in place for mine closure. Every mine should prepare assessments and plans in the following order: (1) Assessment of alternatives for future use; (2) Conceptual Plan; (3) Basic Design; (4) Executive Project. The conceptual plan should be revised once every five years.

A conceptual plan should cover the following:

1. History of the area and the project: the history should go as far back into the past as possible, including the area's features before implementation of the project; a timeline of the project should be put together, outlining key dates in terms of deployment of new facilities or substantial alterations to existing facilities.

2. Baseline: an objective description of the current status of the project's area, containing only relevant information; the baseline should emphasize cumulative environmental impacts.

3. Alternatives for future use: a summary of the study completed earlier.

4. Community expectations: a summary of the survey conducted while preparing the assessment of alternatives for future use.

5. Decommissioning actions: a conceptual description of the actions necessary to achieve the proposed closure objectives; these may include in relation to the biophysical environment: disassembly of equipment, demolition of facilities and buildings with no further use, reclamation of contaminated soils, stabilization of slopes, revegetation, backfilling; in regard to social aspects, the actions could include initiatives to retain key personnel until the cessation of operations, assistance for building capacity with of local suppliers, and economic and social development projects to be conducted under a partnership scheme.

6. Risk analysis: identification of residual risks to human health and, where relevant, ecological risks, after implementation of the recommended actions, including identification of sequences of events that could threaten physical or chemical stability of the area.

7. Monitoring and follow-up: the recommended duration of each monitoring program should be specified; inspections or audits and the preparation of reports; performance indicators should be adopted to evaluate conclusively the results of decommissioning actions.

8. Physical and financial schedule: estimated costs of all actions and programs, including monitoring and security.

9. Guidelines for relinquishment: procedures and arrangements required for relinquishment, including any restrictions on the future use of all or part of the property.

The content of a basic design is similar to that of the conceptual plan, but with a greater level of detail. It should be drawn up five years ahead of the planned date for closure. On the other hand, the content and structure for the executive project, to be drafted two years in advance, will reflect the detailing requirements of each action proposed and approved by the company.

Source: Padrão Gerencial PG-VM-HSMQ-040 Diretrizes para Descomissionamento, revisão 1.1

CASE: TERMS OF REFERENCE FOR VALE'S CLOSURE PLANS

Vale sets out to prepare closure plans for all of its active mines. For the sake of consistency in terms of form and content of its plans, while allowing for flexibility to adapt to the unique features of the individual mines, the company established a master document, which is shared with the consulting firms hired to develop each plan. This document is an internal standard called "Terms of Reference for the Preparation of a Conceptual Mine Closure Plan".

The plan should include the following, among others items:

1. A profile of the project: mining rights, a description of the areas involved and the watershed along which the project is located, a description of operations (main and supporting operations) and facilities of the mine, detailed blueprints.

2. Environmental and socioeconomic profiling of the catchment area (includes performance evaluation of environmental actions undertaken in each mine).

3. Mine closure impact assessment, with an emphasis, but not limited to, the following potentially significant impacts:

    - Reduction in the absolute or relative share of municipal tax revenue from the project;
    - Changing economic dynamics due to loss of economic resources/ benefits afforded by tax revenues;

- Impacts on economic sustainability of the secondary and tertiary sectors, with effects on job and income creation;
- Reduced employment and income levels;
- Economic losses and for the local population and the region;
- Change in local household income and effects on health conditions, education, housing, etc.; and
- Difficulty in maintaining the infrastructure set up by the company (roads, hospitals, schools, water supply, etc);

4. Programs and projects included in the Closure Plan: objectives, criteria for closure and future use, closure activities (e.g. demolition, physical stabilization), environmental rehabilitation and reclamation activities, social and economic programs, post-closure maintenance, and post-closure care, costing and physical and financial schedule.

Source: Vale, PRO-008101, "Termo de Referência para Elaboração de Plano Conceitual de Fechamento de Mina", rev. March 1st, 2011.

To learn more:

Castro, M.F.M.; Lima, H.M.; Flôres, J.C.C. 2011. Panorama do fechamento de mina em Minas Gerais, Brasil. *REM: Revista Escola de Minas 64*(2): 205-211. Available at http://www.scielo.br/scielo.php?pid=S0370-44672011000200012&script=sci_arttext

Western Australia. 2011. *Guidelines for Preparing Mine Closure Plans*. Department of Mines and Petroleum, Environmental Protection Authority.

Best Practice 4.2

Develop decommissioning and reclamation programs

Among closure programs, those covering decommissioning of the structures and facilities and reclamation of degraded areas are among

the most common. Mines of all sizes, whether located in mining-dependent communities or municipalities with a diversified economy, whether in urban or rural areas, need to put these programs in place. In some cases, these two components may represent the essencial of a Closure Plan.

A Decommissioning Plan includes, but is not limited to, the following actions:

- shuttering access to underground excavations;
- disassembly of electrical installations and equipment;
- disassembly of mechanical facilities and systems;
- purging of fluids and removal of solid waste;
- removal or demolition of buildings;
- removal of foundations and buried tanks;
- filling of excavations;
- landfilling, leveling and grading;
- sorting of waste and debris;
- removal and disposal of waste and debris; and
- investigation and remediation of contaminated areas.

Before deciding to demolish a building or facility, it is necessary to take into account the potential usefulness of these assets for the intended future land use. In case of sale meant for an alternative use, buildings or internal pathways may be an advantage; if the future land use is aimed at environmental conservation, some buildings can be used as offices or accommodation facilities, while internal roads may be used for surveillance of the area, although it may also allow intrusions. For these reasons, the Decommissioning Plan, like other components in the Closure Plan, should be designed so as to meet objectives related to closure and future use of the area (see Best Practice 1.2).

Upon completion of each component of a decommissioning plan, for example, the remediation of a former workshop and filling station, it is recommendable to prepare an "as built" report with a detailed description of the work and its results. It is important that this report be integrated into the information and document management system relating to the closure (Best Practice 7.5).

On the other hand, a land rehabilitation plan is an essential part of any mine closure strategy, whatever the intended future use. Such actions help to ensure physical stability and to restore part of the ecosystem services lost with implementation of the mine.

The purpose of reclamation is to make a disturbed area fit for a new land use. As a result, rehabilitation must start long before cessation of a mine's production, enabling the company on the one hand to gain experience, leading to more efficient and effective ways to implement rehabilittion actions. On the other hand, successful reclamation programs that started early enough (Best Practice 2.7) not only contributes to reducing environmental liabilities, but also to build the company's reputation and is positive to relationships with stakeholders (Best Practice 3.2).

In large and medium-sized mines, it may be appropriate to decommission and rehabilitate individual structures once they come to the end of their life, such as waste rock dumps and tailings dams – when their resumption for ore processing is not intended. Particularly in the case of waste rock dumps, it is often possible to put in place procedures for progressive reclamation (Best Practice 2.7).

To learn more:

Neri, A.C.; Sánchez, L. E. 2012. *Guia de Boas Práticas de Recuperação Ambiental em Pedreiras e Minas de Calcário*. Associação Brasileira de Geologia de Engenharia e Ambiental, São Paulo.

Sánchez, L.E. 2001. *Desengenharia: o Passivo Ambiental na Desativação de Empreendimentos Industriais*. Edusp, São Paulo.

Best Practice 4.3

Prepare a Contingency Plan

The importance of managing emergencies is well established in the industry, and many companies have contingency plans to guide the actions required in various situations, such as accidents, failures in technological systems or underperformance. With regard to mine closure, a contingency plan can be helpful in two main situations: during the care and maintenance period and to deal with failures that prevent closure objectives from being achieved (at any stage of a mine's life).

During care and maintenance, the company remains fully responsible for the area, and is expected to ensure safety and to implement maintenance actions for the area. Examples of actions in these cases include inspections and preventive maintenance of fire fighting systems, clean-up and maintenance of stormwater drainage systems, geotechnical monitoring of dams and dumps, etc. The overall objective of the care and maintenance actions is to ensure that the area remains safe and stable, allowing production to be resumed. The purpose of the Contingency Plan is to anticipate actions that will be needed and the resources to implement them. As with other actions, the human resources and materials costs and requirements for implementation of

the actions in a contingency plan must be defined with sufficient level of detail (Best Practice 5.1).

A Contingency Plan can obviously be named differently in order to guide the actions to be performed during care and maintenance. A company may choose to differentiate these actions and those geared towards managing emergencies by preparing separate documents. Thus, a "Mothballing Management Plan" or a "Management Plan for Areas under Care and Maintenance" or even an equivalent chapter in the Closure Plan may be considered more appropriate names by certain companies, but the heart of the matter is the content of the plans and the actual ability to implement.

The overall objective of the care and maintenance actions is to ensure that the area remains safe and stable, allowing production to be resumed.

According to some sources, immediately after suspension of operations, an audit should document the state of the industrial and support facilities, as well as the geotechnical structures, proposing any necessary actions to ensure their stability and integrity during the stoppage. A Contingency Plan drafted in advance would be revised and detailed at that time.

Typical actions in this phase include erosion control in waste rock dumps, access roads and other areas; geotechnical and hydrological monitoring of tailings disposal facilities, purging of fuel or chemicals from tanks, etc. Inspections and monitoring are part of this set of actions. The Contingency Plan should contain all such measures and an estimate of their respective costs. Finally, emergency actions in case of accidents or other events should be planned, considering that the engagement of potentially affected communities is essential to ensure that such plans are successful in preventing economic losses and, in particular, protecting human lives.

Similar arrangements can be made to avoid failures that hinder closure objectives to be met. Inspections and environmental and safety audits can detect problems before failures or accidents occur. These tools are usually part of procedures and management systems – for example, environmental management systems that are compliant with the ISO 14001 Standard and dam safety protocols – so that the company's prior experience can be harnessed for preparing a Contingency Plan as part of the mine closure planning.

To learn more:

Emery, A.C. 2005. *Good practice in emergency preparedness and response*. UNEP, United Nations Environment Program/ ICMM, International Council on Mining & Metals. Paris/ London.

UNEP, *United Nations Environment Program*. 2001. *APPEL for Mining: Guidance for the Mining Industry in Raising Awareness and Preparedness for Emergencies at Local Level*. UNEP Division of Technology, Industry and Economics, Paris.

Western Australia. 2011. *Guidelines for Preparing Mine Closure Plans*. Department of Mines and Petroleum, Environmental Protection Authority.

Best Practice 4.4

Develop social programs

Mine closure planning should include social programs specially designed to be implemented in a context in which mining operations will be discontinued or will have already ceased after running for a long period of time. The development of social programs in this context should particularly consider the degree of dependence the host community has from the mining business. Other variables such

as income level, education level, job structure, and local human capital should be considered, and may help designing these programs.

Appropriate linkages with local and regional development policies should also guide the design of social programs. If throughout a mine's life the company developed and evaluated the results and social benefits to the community arising from its social programs, it will certainly have the best inputs available to propose new programs or follow up on those against the backdrop of mine closure.

Social programs designed during the process of mine closure planning should have as assumption a long-term sustainable development model at local level, i.e., it should seek to provide lasting benefits to the community.

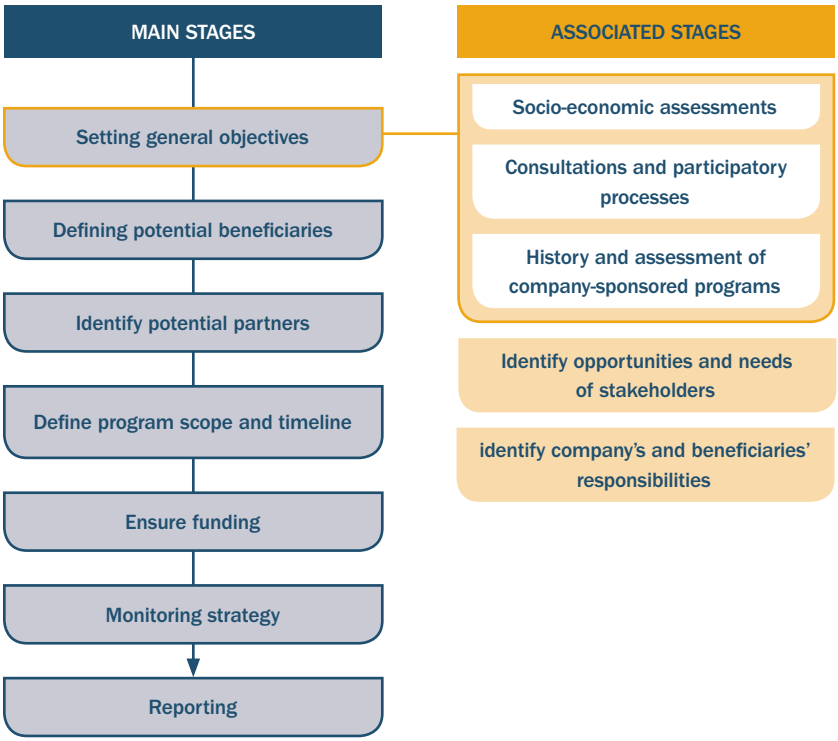
In general, the objectives to be pursued are consistent with the promotion of skills and abilities for members of the host community, promotion of activities not related to mining that may lead to the diversification of the local economy. The engagement of stakeholders in this process, based on participatoryapproaches especially designed to reveal demands and skills, discuss and satisfy community expectations, is critical for these programs to be successful.

Implementation of social programs may rely on partnerships with, municipalities, NGOs or other civil society organizations. Various techniques to approach and consult with stakeholders are available to engage with them in the development of social programs. Selection of these techniques should consider the unique features of the individual contexts - they ranges from personal interviews, workshops, focus groups, public meetings or hearings, to qualitative surveys and polls. Each technique involves advantages and disadvantages that should be carefully considered given the environment where the company operates.

Setting priorities that will guide the company's investments in the implementation of social programs from the perspective of closure should consider:

1. results and outputs from stakeholder consultations;
2. socio-economic studies that are able to generate information on future trends, based on which it is possible to outline scenarios without the presence of mining; and
3. potential interaction with the local authorities, other government agencies and civil society organizations.

Figura 8: Development of social programs



Examples of social programs especially designed with mine closure planning in mind include:

- programs to strengthen public administration with a view to enhancing the managerial capacity of local governments;
- programs to promote the establishment of local;
- development agencies or councils;
- programs for retraining or providing a new job to workers to be laid off once the mine closes;
- upgrade programs for local suppliers; and
- training programs for civil society organizations.

CASE: VALE'S INOVE PROGRAM

In order to foster business among the members of its supply chain, promote growth of local businesses, generate jobs and income, Vale designed a program called Inove. Vale's intention is to foster development of its suppliers in the areas where it operates so that these businesses are prepared to meet the demands of an evolving market. Inove is a three-pronged program: (i) a financial component, with the main objective of providing lines of credit with more attractive rates and distinct maturities to suppliers; (ii) a training component intended to promote qualification of suppliers with the enhancement of technical and business skills through educational activities inside and outside the company, based on a range of customized courses; and (iii) a business component to spur business with the inclusion of associations, government agencies and large corporations. The program seeks to establish an interface between small and medium-sized suppliers of large buying companies and encourage large suppliers to establish offices in the areas where Vale operates, with the support of local businesses.

Source: Vale

To learn more:

Fundação Getúlio Vargas. 2006. *Juruti sustentável. Uma proposta de modelo para o desenvolvimento local*. Fundação Getúlio Vargas, Centro de Estudos em Sustentabilidade/Alcoa, São Paulo.

IBRAM, Instituto Brasileiro de Mineração; ICMM, Conselho Internacional de Mineração & Metais. 2012. *O setor de mineração no Brasil: criar instituições para o desenvolvimento sustentável*. Mineração parcerias para o desenvolvimento – Série Spolight 17.

ICMM, International Council on Mining & Metals. 2012. *Community Development Toolkit*. ICMM, London.

Best Practice 4.5

Assess and manage risks involved in the closure actions and programs

A risk assessment of existing facilities (Best Practice 2.5) is recommended for all active mines where a closure planning process is launched. In addition, the practice of assessing and managing the risks of closure actions and programs is suggested for both new and existing projects, either for the preparation of the first conceptual plan or for update purposes, as well as for basic and detailed plans (Best Practice 4.1).

QA risk based approach applied to closure planning helps to reduce costs and deal with uncertainties. Table 5 shows five categories of risk associated with mine closure. Its management entails, as in other situations, prioritization where resource allocation is commensurate with risks. Table 6 summarizes the main risk concepts applicable to risk management within mine closure planning, according to the ISO 31000: 2009 international standard.

Table 5: Closure risk categories

Category	Description
operational risks affecting closure	costs to deal with or mitigate these risks affect the operating budget of a mine
risks in the planning of programs that make up the closure plan	affect implementation in quantitative terms, technical specifications, schedule, and unit costs
risks for program and project implementation that make up the closure plan	affect management of program and project implementation and the corresponding contingency reserves
post-closure residual risks	affect the amount of funds to be allocated for contingencies related to uncertain events in the post-closure phase (e.g. repair of damages to the drainage system after a rainfall levels not seen in a century)
closure management risks	affect the amount of funds to be allocated to manage the decommissioning and post-closure phases which, as they go on for years, can be high

Source: adapted from Bentel (2009)

Table 6: Risk management terminology

Term	Concept
Risk	effect of uncertainties on objectives (environmental, health and safety, financial)
Risk management process	systematic use of management policies, procedures and practices to the following tasks: communication, consulting, establishing the context, identifying, analyzing, evaluating, treating, monitoring, and reviewing risks
Risk assessment process	general process to identify, analyse and evaluate risks
Risk analysis	process to understand the nature of the risk and ascertain the level of risk
Level of risk	magnitude of a risk or a combination of risks, expressed as a combination of consequences and their likelihood
Residual risk	risk that remains after risk treatment
Risk treatment	process to change risk, how to avoid risk by failing to perform a given activity, increase the risk in order to seize an opportunity, remove the source of risk, act on the likelihood or consequences, sharing risk with other parties, accept risk through an informed decision

Source: adapted from ISO 31000: 2009

The closure plan may be considered as a project that should be periodically assessed for risk. If unacceptable risks for the company are identified, then the project should be reviewed and comply with the relevant criteria. Risk assessment makes it possible to identify the most appropriate closure actions, with a focus on the most relevant risks, allowing for comparison between risk management options and for the selection of the best practices on mine closure. Every action or program contained in the closure plan can be subject to a risk analysis.

To learn more:

Australia, Department of Industry Tourism and Resources. 2006. *Mine Closure and Completion.* Canberra.

Heikkinen, P.M.; Noras, P.; Salminen, R. (eds.). 2008. *Mine Closure Handbook.* Geological Survey of Finland, Espoo. See Chapter 4, Environmental Impact Assessment and Risk Assessment in Mine Closure.

ISO, International Organization for Standardization. 2009. *ISO 31000: Risk Management - Principles and Guidelines*. ISO, Genève.

GUIDELINE 5

MINING COMPANIES SHOULD ESTIMATE ALL COSTS ASSOCIATED WITH THE CLOSURE OF A MINE

The cost of closing a mine can be significant, especially in cases involving acid drainage, but also those involving large tailings dams. There are several challenges to achieve an accurate estimation of closure costs, but it is of utmost importance that these are addressed.

One such challenge lies in the fact that most of the expenses related to closure are not incurred until production ceases. This has two implications. First, expenses will be incurred after the revenue stream has ended. For companies that have a portfolio of several mines, this is not a major challenge insofar as the costs may be covered by revenue generated from other mines.The real problem lies somewhere else: if this company decides to sell a mine to a third party, the collateral represented by the remaining assets is no longer of avail. For this reason, in many countries a collateral is required for each mine, which must be enough to cover all expenses to implement closure programs, including those required for the post-closure stage.

A clear distinction must be made between collateral and financial provision. The former is provided in favor of third parties, whereas the latter is an internal accounting tool. In other words, the purpose of financial assurance for mine closure (or for reclaiming a degraded area or any other purpose) is to be enforceable by a third party (usually a government agency), if the company fails to meet its commitments (i.e., deploying all programs specified in the closure Plan or achieving certain completion criteria). Therefore, the collateral may take the form of a deposit, insurance (particularly a surety bond), financial guarantee, the creation of a fund or other legally binding instrument acceptable in the jurisdiction where the mine is located. In contrast, a financial

provision is accrued internally by the company, which does not need to disburse an equivalent amount or pay a premium. For this reason, financial provisions can be made voluntarily by companies (or, in the case of publicly traded companies that are listed in certain markets such as the U.S., as determined by the regulatory authority of the capital market). In either case (collateral or financial provision) an estimate of the cost for implementing closure actions is required, which in turn forms the basis for determining the amount for the collateral or financial provision. This estimate is somewhat challenging.

The second implication arising from the fact that most of the closure-related expenses are not incurred until production has ceased stems from the fact that these expenses are incurred in the future, so the present value of the estimated expenses are quite low. From the perspective of the present value, closure costs will have little influence on the economic feasibility assessment for a new project. As a result, some companies limit the life of a mine – for the sole purpose of estimating costs and calculating provisions – to periods such as thirty years. Spreading out some of these costs throughout the operating phase (such as results of Best Practices 1.4, 1.5 and 2.5) minimizes this problem, as actions aimed at achieving closure objectives will have already been implemented. On the other hand, regulations issued by securities market regulators require the company to maintain a provision for asset retirement by the end of every fiscal year.

In spite of such limitations, once these difficulties have been acknowledged, there is no doubt of the importance of estimating closure costs accurately.

The following practices help to implement this guideline:

Best Practice 5.1 Estimate the costs of closure-related programs
Best Practice 5.2 Regularly update cost estimations for closure-related programs
Best Practice 5.3 Make fund provisions for closure

Best Practice 5.1

Estimate the costs of closure-related programs

A Closure Plan should list the programs to be conducted during the operation, decommissioning and post-closure phases. Each program can then have its costs ascertained in order to draw up a general picture of costs. Framing certain costs as "operational" or "closure-related" is a matter to be dealt with internally by each company as there are no clear boundaries between these categories. Regardless of the accounting standard, there is no doubt that a sound closure plan contributes significantly to an accurate estimate of closure costs.

As specific programs during the decommissioning and post-closure phases usually involve an increasing level of detail, margins of error should ideally be progressively smaller. The accuracy of estimates is influenced by uncertainties. As certain types of uncertainties are reduced as the planned date for cessation of production draws closer, the margin of error associated with the cost estimates should be progressively lower. Table 7 displays some of the usual cost items to be considered.

Table 7: Main items of closure cost

(i)	Earthworks and landscaping;
(ii)	Management of problematic materials as appropriate;
(iii)	Post-closure management of run-off drainage;
(iv)	Surveys and testing;
(v)	Decommissioning and removal of infrastructures;
(vi)	Remediation of contamination – research program, reclamation program, maintenance and monitoring (progressive and final reclamation);
(vii)	Maintenance and monitoring programs, including post-closure phase;
(viii)	Program to engage the internal and external stakeholders;
(ix)	Labor expenses/costs;
(x)	Social programs maintained after closure;
(xi)	Costs of managing closure projects: administration, specialists and consultants' fees, legal requirements, financial provision for early and temporary closure (care and maintenance);
(xii)	Provision for installation of additional infrastructure as required by the future land use agreement;
(xiii)	Provision for potential delays, extreme events, or other factors that are relevant to closure; and
(xiv)	Costs for the contingency plan and care and maintenance actions.

Estimating closure costs has been a major challenge faced by consultants assisting with closure planning, as mining companies rarely provide consultants with unit costs to estimate total closure costs.

To learn more:

du Plessis, A.; Brent, A.C. 2006. Development of a risk-based mine closure cost calculation model. *The Journal of the South African Institute of Mining and Metallurgy*, June, p. 443-450.

ICMM, International Council on Mining & Metals. 2008. *Planning for Integrated Mine Closure: Toolkit.* London. See Tool 10, Cost Risk Assessment for Closure.

Western Australia. 2011. *Guidelines for Preparing Mine Closure Plans*. Department of Mines and Petroleum, Environmental Protection Authority.

Best Practice 5.2

Regularly update cost estimations for closure-related programs

The first estimate of costs associated with the closure of a mine should be prepared during the feasibility study phase. Every update of the closure plan should include revised costs should also be revisedthat reflect a complete revision of amounts and unit costs for each action or program.

There are, therefore, two approaches to revising estimated closure costs. The first approach is to do the revision whenever the plan is updated. Thus, whenever a plan is revised, the programs are adjusted and their costs are estimated, and the margin of error should be minimized. The other approach is the annual update for accounting purposes, which involves adjusting the financial provision required.

CASE: VALE'S CLOSURE COSTING PROCEDURE

Since 2003, Vale has had an internal procedure in place for estimating closure costs in order to make the necessary accounting provisions. As a listed corporation, it has to comply with equity market regulations. Thus, the company established its procedures for estimating asset retirement (in accounting terms) costs, i.e., all expenses to be incurred to meet retirement obligations (legal obligations or otherwise) (i.e., for the decommissioning and post-closure phases, according to the terminology used in this Guide) of a mine or related facilities (such as a waste rock dump).

The Vale internal procedure provides guidelines for estimating costs which include: (1) setting a calendar day to undertake the calculations; (2) using unit costs of services, materials and equipment drawn from the market, rather than internal company costs or charged by suppliers at the time of estimating the costs; (3) assigning zero as the residual value for plant and equipment; and (4) considering the cost implication of social and economic programs under the Closure Plan. Note that guideline (2) above is also adopted internationally for calculating the collateral to be filed with government agencies, as in cases where a mining company defaults, the services required are considered to be an obligation upon third parties.

Costs should be estimated for the three "phases" of retirement known as "prior actions", "typical actions" and "monitoring and maintenance". These three phases of retirement correspond to project preparation, implementation and monitoring. Hence, the following actions should be entered in the books as closure costs: investigation of contaminated areas; project design; obtaining clearances; execution of drainage works; earthmoving and other works related to soil and rock; removal of facilities; vegetation restoration; and management and supervision, which are commitments arising from legal obligations and everything that relates to monitoring and maintenance.

An important guideline is that costs should be spread over the years by linking them to cash flows and adjusting them to their present value. The calculation system is supported by worksheets, with one worksheet for each of the following structures: pit, underground mine, dump, dam/dike, industrial facilities, infrastructure and

pipeline. For each of these, the applicable actions are selected and their amounts (e.g. hectares to be reclaimed with native plant species), unit costs (in this example, the cost per hectare), and the total cost of each action, spreading them throughout the years. For monitoring and maintenance, a period of five years is considered after implementation of planned actions.

Finally, the document specifies the procedure to be used regarding the disbursements associated with the implementation of the planned actions. If the actions exceed the expected amount, these contingency costs shall be charged to the mine in question, which will affect its operating income. This allocation of costs should encourage the best possible calculation of closure costs. Records and documents evidencing the effective allocation of these disbursements should be kept on file, including as built projects. The obligation of preparing a "final report" on the "effectiveness of actions" should also be noted, including a description of post-closure monitoring and maintenance tasks.

Source: Vale, PRO-000023 "Desmobilização de ativos e liberação da provisão para desembolso financeiro", revisão 6, March 2011

Best Practice 5.3

Make fund provisions for closure

Regardless of any legal requirements, it is a widely recognized best practice for mining companies to set up fund to deal with the potential cost associated with the closure of the mine. The accounting rules for the relevant jurisdiction will have to be followed, but the basic advice is always to have funds set aside that are sufficient to cover all foreseeable expenses related to closure (program costs) plus a percentage (to be set on a case-by-case basis such as 10%) for contingencies. Assets sales should not be considered as a source of revenue for calculating the provision. To be credible, provisions should be audited by an independent third party.

A fund provision should increase rapidly during the early stages of mine development, and then grow slowly or remain constant during the operation stages (in case there is progressive reclamation - Best Practice 2.7). Completion of reclamation works on waste rock dumps can be an opportunity to review the provision.

The extent to which reclamation or other objectives are achieved is often taken for granted both by companies and by government agencies. Implementation of a program or project does not mean that its objective will be achieved, and it is necessary to measure and evaluate the results based on indicators that were previously selected and agreed on with stakeholders. In Brazil and in several other countries, the question whether a particular area "is reclaimed" is often approached subjectively or bureaucratically, i.e., instead of trying to verify whether reclamation objectives were met, the only verification is whether the actions described were implemented.

The release of internal provisions or the redemption of collateral previouly set aside to fund closure costs should only be done upon clear evidence that the objectives and targets of each program have been achieved, and not just by the fact that a given obligation was performed.

To learn more:

ANZMEC/MCA, Australian and New Zealand Minerals and Energy Council/ Minerals Council of Australia. 2000. *Strategic Framework for Mine Closure*. Canberra.

ICMM, International Council on Mining & Metals. 2006. *Guidance Paper: Financial Assurance for Mine Closure and Reclamation*. ICMM, London.

Sánchez, L.E. 2005. Danos e passivo ambiental. In: Philippi Jr., A.; Alves, A.C. (eds.), *Curso Interdisciplinar de Direito Ambiental*. Manole, Barueri, p. 261-293.

GUIDELINE 6

MINING COMPANIES SHOULD MONITOR SOCIO-ECONOMIC DEVELOPMENT

The impact on the local and regional economy caused by a mining project depend on factors such as the size and level of investment and the economic dynamics of the host region. The literature and experience have shown that a number of economic impacts are to be expected, the most important usually being:

- increased employment levels and total payroll;
- increase in average real wages and an overall increase in conditions of employment;
- increased tax base, with potential to expand investments in primary social services for health care, education, infrastructure, etc.;
- establishment of an environment conducive to local and regional development with the potential to diversify the economy; and
- improving the qualification of the local workforce expected to work in the mining sector.

The mining industry can help bring about a cycle of economic growth in the municipalities where it is located, and help raise levels of *per capita* income, with positive effects potentially extending to a wider area. One cannot expect, however, that the growth rates at a given moment of deployment and initial operation of a project will last for decades and ensure constant levels of economic growth.

It is necessary to understand the nature of long-term economic expansion cycles and opportunities for growth in the municipalities and regions where a particular industry operates.

This business cycle depends not only on the characteristics of mining, but also on general market conditions. In addition, the extent to which the window of opportunity opened up by mining create new jobs and income generation should be looked at, along with the possibility of making economic growth through sustainable development policies for the benefit of future generations. An investment in the mining business can have multiplier effects generated by the demand for services (security, transportation, food, maintenance of facilities and equipment, etc.), which can be driven by the demand for family/ personal services and non-durable consumer goods.

In the case of municipalities where mining is the main economic activity, understanding the stages of the long cycle of economic growth triggered by the arrival of mining provides critical inputs for closure planning. This is all the more important the higher the degree of dependency of the municipality on mining.

The economic dependence of a mining-oriented municipality is also directly associated with the revenue generated by the mining business, including royalties, goods and services taxes, local taxes, etc. These taxes increase mostly during implementation stages and to a lesser degree at the end of the operation as a result of new services and demands associated witht the mining business located in the municipality. The greater the proportion of these revenues, the greater the importance of the mining activity to the local economy.

In addition to spurring economic growth, the mining industry in a particular community should be able to contribute to the community's actual development in a sustainable manner so that it can develop independently, especially after mining comes to an end. The mining industry can play a pivotal role in community development by pursuing initiatives that promote conversion of a local asset – the non-renewable natural resource – into a another local asset of a different nature, i.e., human and social capital. To this end, the strategic long-term corporate goals of the mining company should be

aligned with current and future development plans of the community and the region. The company should engage stakeholders and pursue initiatives aimed at strengthening the capacity of the community in tandem with the local government. Ideally, these principles should be in place from the earliest stages of a mining project, and they should be carefully considered during the decommissioning stage.

Thus, mine closure planning should take into consideration:

- the nature of the economic growth cycle triggered by the mining business, its stages and characteristics;
- the amount of tax revenues that is directly or indirectly
- associated with the mining sector in relation to the total revenue;
- the ability to diversify the economic base from the opportunities generated by the presence of the mining business; and
- the ability to contribute to the community's sustainable development.

The following practices help to implement this guideline:

Best Practice 6.1 Analyse the local and regional socio-economic context

Best Practice 6.2 Monitor development and indicators of living standards

Best Practice 6.3 Develop programs that support a diversified local production base

Best Practice 6.4 Implement programs geared at community development

Best Practice 6.1

Analyse the local and regional socio-economic context

Planning for the closure of a mine should include a survey of or update and analysis of social and economic data that could make up a baseline study to describe and understand the local and regional socio-economic dynamics. Socio-economic studies are conducted in the early stages of the project as part of social impact assessments. In general, these studies are based both on secondary data provided by population censuses, government agencies and research institutes, and relevant data collected locally.

Closure planning should consider these baseline studies, update them and supplement them if necessary. Lengthy data compilations should be avoided as they usually fail to provide relevant information of the local context, that are key to planning the closure of a mine. A survey based on custom-made interviews and questionnaires are extremely useful tools. A baseline study covers topics such as: (i) aspects of demography; (ii) economic structure and dynamics; (iii) basic infrastructure and services; (iv) public finance; and (v) social organization and socio-political environment.

In closure planning, some aspects deserve special consideration and understanding such as the knowledge of the supply chain, especially of locally and regionally sourced goods and services. Detailed knowledge of this issue will provide important information to assess changes that could occur during the post-closure phase of a mine. Similarly, accurate information on the local and regional labor market, its current dynamics and future trends will be particularly valuable at this stage in view of the jobs lost as a result of mine closure.

The characteristics and conditions of the local and regional market should be analysed and monitored prior to decommissioning a mine

in order to allow different alternatives to be appropriately considered as workers look for new jobs, ideally with support of the company while it remains in the area.

Some questions can guide an analysis of the local socio-economic context and its degree of dependence on the mining business:

- Was mining responsible for the development and maintenance of the municipality's socio-economic exuberance?
- Is the presence of the mine essential for the local economy to thrive?
- Is the mine the primary source of local jobs?
- How many new jobs would be sufficient to ensure the local economy can thrive?
- What are the main goods and/or services purchased at the local and regional community?

To learn more:

ICMM, International Council on Mining & Metals. 2013. *The Mining Sector in Brazil: Building Institutions for Sustainable Development*. ICMM/IBRAM - Instituto Brasileiro de Mineração, London.

IIED, International Institute for Environment and Development / WBCSD, World Business Council for Sustainable Development. 2002. *Breaking New Ground. Mining, Minerals and Sustainable Development*. Earthscan, London. See Chapter 9, Local Communities and Mines.

CASE: MINING AS A SHARE OF MUNICIPAL TAX REVENUES

According to a study conducted by IBRAM in the State of Minas Gerais, mining royalties, as a share of total government revenues accounted for a mere 0.19% on an annual basis. However, in some municipalities covered in the study, this mining revenue represented more than 20% of their total tax revenues. Likewise, data from the State of Pará, which is also a major source of mining royalties, showed that this tax as a share of total revenues was very modest, accounting for only 0.44% of the average annual tax revenues. As in the case of Minas Gerais, some municipalities in Pará reported that mining royalties accounted for more than 20% of their total tax revenues. Moreover, considering all taxes, duties and financial charges that make up municipal revenues, the contribution from mining royalties reached up to four times more than financial support from the federal government. Information of this nature can provide great insights into the socio-economic context and into the impacts of mine closure.

Source: IBRAM, 2011

Best Practice 6.2

Monitor development and indicators of living standards

A social and economic indicators system is a valuable tool which may help the mining company better understand the local environment. To plan for mine closure, indicators can help to systematically monitor changes that might occur during the decommissioning and post-closure stages. Indicators can also be used to assess the results of programs aimed at the mitigation of socioeconomic impacts of mine closure.

Social and economic indicators depend on the existence of a robust and consistent monitoring program geared to the collection of data concerning the parameters or variables to be assessed. The most

relevant variables should be selected for the particular stage of the life of the mine, and they should be capable of showing the social and economic situation at the local level and whether the community is able to develop sustainably in the absence of the mining operation.

Ideally, corporate programs should include from its inception indicators that provide information that make it possible to continuously assess to what extent the presence of the company is in fact contributing to local development. Furthermore, indicators should help to develop benchmarks and to identify trends. Indicators can be either quantitative or qualitative.

The literature points to a wide range of well established instruments currently used for the implementation of a set of indicators. However, one must take a case-by-case approach when building a system of indicators. Overall, their selection should take into account some basic criteria such as:

i. being representative of the phenomenon to be tracked;
ii. being relevant;
iii. being simple and easy to interpret; and
iv. serving as the basis for making decisions when appropriate.

It is always recommended that the design of indicators be based on a participatory process. By involving the direct stakeholders, indicators can be more suited to the local environment, i.e., it becomes easier to decide on "what is important to follow." In addition, a participatory process contributes to the engagement of the community and its empowerment to address issues of collective interest.

Table 8: Examples of relevant indicators for closure planning

- GDP and *per capita* income growth rates (rates that remain positive and high for a long period of time such as two decades could indicate that the economy tends towards sustainable growth)
- number of new enterprises in the municipality or region
- Number of civil society associations, number of industry councils, number of meetings per year (engagement of human, material and institutional resources intended to retain and reinvest the economic surplus derived from local growth)
- Municipal tax revenues
- Percentage of workers finding a new job
- Average unemployment rate in the municipality
- Aaverage unemployment rate among young people
- Total number of formal jobs
- Number of new companies starting operations in the municipality and number of companies going out of business
- Municipal Human Development Index (HDI)

To learn more:

Silva-Sánchez, S.S.; Sánchez, L.E. 2011. Mineração de fosfato em Cajati (SP) e o desenvolvimento local. In: Fernandes, F.R.C.; Enríquez, M.A.R.S.; Alamino, R.C.J. (eds.), *Recursos Minerais e Sustentabilidade Territorial,* vol 1: Grandes Minas. Cetem, Rio de Janeiro, p. 163-197. Available at http://www.cetem.gov.br/publicacao/livros/Vol_1_GRANDES_MINAS_TOTAL.pdf

CASE: DEVELOPMENT AND VALIDATION OF INDICATORS FOR THE JURUTI MINE

In 2006, after having obtained the operating license for a new bauxite mine in Juruti, in the State of Pará, Alcoa set out to design development indicators to track social, economic and environmental changes in the region. The so-called "Juruti Indicators" were based on a participatory process involving the community and local leaders, regional government authorities and civil society organizations. , This broad-based process of social engagement took the form of stakeholders takin part in workshops and expanded public consultations. The participatory design of the Juruti development indicators resulted in an effective tool to measure the changes in the municipality and region over time. Furthermore, it formed proposals for public policies and private investments in the region, thus allowing enhanced planning based on data and the development of future scenarios. The indicators included more than one hundred and sixty items of information organized into ten topics: health, education, vulnerable groups, local economy, transportation, security, tourism, fauna and flora, water, and climate. In 2011 the second edition of the "Juruti Indicators" was released. The second edition of these indicators demonstrated, significant progress in data collection and reinforcement of the participatory process by engaging a variety of stakeholders, encouraging reflection and group discussions, and strengthening the community and social inclusion.

If both monitoring of these indicators and process improvement continues, a repository of enormous importance and usefulness for planning mine closure and diversification of the local economy will have been established.

Sources: Fundação Getúlio Vargas. 2006. Juruti Sustentável. Uma proposta de modelo para o desenvolvimento local. Fundação Getúlio Vargas, Centro de Estudos em Sustentabilidade.

Fundação Getúlio Vargas. 2009. Indicadores de Juruti. Para onde caminha o desenvolvimento do município. Fundação Getúlio Vargas, Centro de Estudos em Sustentabilidade.

Fundação Getúlio Vargas. 2011. Indicadores de Juruti. Monitoramento 2011. Fundação Getúlio Vargas, Centro de Estudos em Sustentabilidade..

Best Practice 6.3

Develop programs that support a diversified local production base

Closure planning should provide for the adoption of programs designed to develop the skills and abilities of the community and its members while promoting the development – or creating the conditions for this to occur – of other activities that are independent of mining, thus diversifying local economy.

It is therefore necessary to create mechanisms to ensure development and implementation of a local sustainable development model focused on the long-term in order to promote economic and social development, and to enable diversification of the economy by fostering new employment and income alternatives and by multiplying institutional partnerships. This process cannot succeed without the participation of civil society and the local government.

By the same token, the company should pursue various initiatives, such as sharing with the community knowledge and skills in trade, administration, finance, logistics, and supply management, for example, by providing training to local actors such as small traders and entrepreneurs. Improving the skills of suppliers of goods and services at local and regional level makes it possible to expand their coverage to industries other than mining. Literacy programs for adults or training for young adults go along the same lines – such initiatives can be a source of value for the community. These programs and projects need to be long-term and, most importantly, cannot take a short-sighted, paternalistic character.

In rural communities, it is possible to implement programs that strengthen and integrate agricultural production into the mining supply chain. In many cases, the arrival of a large mining project means a decline of local agriculture, as most of the agricultural products required by the

mine end up being acquired outside the community. Thus, from the early stages of mining production it is important to take actions that strengthen local agriculture, especially smal family farms, thus favoring a sustainable activity that is able to thrive after the mine closes.

The basis for developing a sound closure plan that includes programs to encourage diversification of the economy is adequate knowledge of the local environment, its needs and capabilities. This includes identifying economic opportunities for the community and the region to create jobs and income, identifying local interest groups and leaders, and knowledge of the social and cultural aspects of the community. In places that are highly dependent on the mining project, more pragmatic actions based on the engagement of previously identified and organized economic opportunities are extremely useful. In places with a more advanced economic base, the municipality or region may be in a better position to attract national and international public and private resources (e.g. financial, technological, institutional, etc.).

The higher the dependence, the greater the role of the mining company to foster partnerships and pursue actions aimed at diversifying the economy, since mine closure may cause socioeconomic impacts of great magnitude and importance. Indicators of the municipality's economic dependency on mining can be based on, for example: (i) the relationship between the mine's net revenues and the municipal GDP; (ii) the relationship between the number of employees and contractors at the mine and the city's workers who are currently employed; and (iii) the relationship between the share of mining royalties in the municipality's total revenues. Such data can be obtained from official sources and supplemented by data from the company itself.

Additionally, one should consider whether or not there are other mining activities in the municipality. Dependency levels can vary widely. Once this dependence has been ascertained, the focus of the social programs under the Closure Plan should be on diversification of economic activity by assisting former employees to qualify for new job.

To learn more:

Esteves, A.M. 2008. Mining and social development: refocusing community investment using multicriteria decision analysis. *Resources Policy* 33: 39-47.

Esteves, A.M.; Barclay, M.A. 2011. Enhancing the benefits of local content: integrating social and economic impact assessment into procurement strategies. *Impact Assessment and Project Appraisal* 29(3), 205–215.

IFC, International Finance Corporation. 2010. *Strategic Community Investment. A Good Practice Handbook for Companies doing Business in Emerging Markets*. IFC, Washington.

http://commdev.org. This website is a repository of information, public documents, tools, case studies, guides, best practice examples and studies produced by IFC and other organizations to guide the actions of companies with a view to engaging the affected communities and promoting local development.

Best Practice 6.4

Implement programs geared at community development

Mine closure planning should, considering the post-mining scenario, include programs to promote community development and create the foundation for a sustainable community in the long term. Community development refers to the process of boosting effectiveness and strengthening communities with a view to improving living standards and the ability to participate in the decision-making process regarding issues of collective interest.

Such programs should be designed and implemented during the early stages of the project by establishing a link between the sustainable development of the community and the development of a mining

project throughout its lifecycle. If these programs are already a corporate practice, it is recommended that they are reviewed during the mine closure planning process with the perspective as to whether there may be effective results once mining activities are discontinued. At the decommissioning stage, the results of these programs should already be well established.

Objectives for programs and initiatives aimed at community development need to encourage the self-confidence of its beneficiaries, including vulnerable and disadvantaged groups. These programs should also target the workers employed by the mine. This is particularly important when the mine engages workers from the local community or region, as new technical skills can be transferred to the community.

The focus should always be to develop capabilities that may be important to the community in a post-closure scenario. Skills and knowledge acquired through these programs should have the potential to be transferred to other segments of the economy beyond the mining company itself.

The engagement of local government, civil society organizations and the local community is an important prerequisite for these programs to be successful and for achieving their objectives. It will be necessary to conduct a detailed survey and analysis of needs and skills of the community. Such information could guide the company to select those aspects that deserve to be worked out, to evaluate the possibilities, advantages and disadvantages of joining organizations that already operate locally or in the region, thus avoiding duplication of efforts or strengthening those that have proven to be promising.

The company may encourage and support the creation of local social networks that bring together various social players and public officials such as, from local or regional development agencies or councils. Ideally, such local social networks such should be set up in the initial stages of the project but, if this is not the case, it is recommended

that closure planning consider this possibility. A development council or agency should abide by the principle of public participation and transparency so as to ensure that experiences and information can be shared. Thus, social ties and trust of society in its development potential can be strengthened. Among other things, the local social networks will be tasked with discovering potential development opportunities apart from the mining activity.

Over the past few decades, it has become common to create foundations and trusts - and, more recently, community foundations - dedicated to the management of funds and other benefits generated by mining, with a view to the sustainable development of the affected communities. These institutional models should not be confused with the legal obligations of the mining company to mitigate or offset environmental and social impacts, and always represent an additionality to taxes and mandatory fees. These institutional models vary in their structure, but have the common goal of developing and implementing action plans and social programs aimed at long-term community development.

Information is also a crucial factor in the development and implementation of programs aimed at community empowerment. The exchange of information is the connecting hinge that is able to foster the construction of stable social relationships, and enabling the promotion and strengthening of social capital in a given community. The social capital refers to the capacity and ability of citizens to interact in order to reach agreement on a shared goal, convergence of collective interests and strengthening the community.

Sustainability of community development depends on the design of programs that promote participation of the beneficiaries and the development of social capital.

To learn more:

Esteves, A.M.; Barclay, M.A. 2011. New approaches to evaluating the performance of corporate-community partnerships: a case study from the minerals sector. *Journal of Business Ethics* 103: 189-201.

ICMM, International Council on Mining & Metals. 2012. *Community Development Toolkit*. ICMM, London. See Tool 17, Local Economic Investment.

World Bank. 2010. *Mining Foundations, Trusts and Funds*. A Sourcebook. World Bank, Washington.

World Bank. 2012. *Mining Community Development Agreements Source Book*. World Bank, Washington.

CASE: CREATION OF COMMUNITY COUNCILS - VOTORANTIM CIMENTOS

Votorantim Cimentos, through the Votorantim Institute, has been implementing "Community Councils" in municipalities where it operates. In 2009, the company established Councils in three pilot sites: Laranjeiras-SE, Itaú de Minas-MG, and Sobradinho-DF.

Community Councils claim to be channels of communication and relationship with the community, bringing together leaders, local government, social organizations and trend-setting leaders, with the aim of finding solutions to local problems.

Following a methodology of its own, the creation of each council starts with a "mapping of the local reality "and then draw specific goals, including actions aimed at improving the socio-economic indicators of the municipality and strengthening social capital. Although it is a company initiative, the Community Council is an independent body.

Many social programs developed by Votorantim were originated based on questions identified during the meetings of the Community Councils. The company expects that these institutions can contribute, inter alia, to the creation of a municipal development agenda that identifies opportunities and projects that result in benefits to the community.

Source: http://www.institutovotorantim.org.br/pt-br/fiqueDentro/Publicaes/Conselhos_Comunitarios.pdf

GUIDELINE 7

THE CLOSURE PLAN SHOULD BE UPDATED WHENEVER THERE ARE SUBSTANTIAL CHANGES TO THE MINING PROJECT OR CONDITIONS IN THE SURROUNDING AREA

Many changes occur during the life of a mine. It is natural to expect internal changes such as updates to the mining plan, identification of new mineral deposits, development of new technological processes, changes in corporate management or shareholder control, accidents, etc. Changes also occur in the external environment. Ore prices fluctuate, regulations evolve, community expectations change.

These events, along with uncertainties regarding the future, are no reason to delay closure planning. Rather, Best Practice 1.1 teaches that strategic planning should include closure of each mine, and every strategic plan deals with uncertainties and should prepare the organization to adapt to changes.

A revised and updated Closure Plan should obviously reflect the changes or adjustments in closure planning. It is not enough to update the Plan – one should have a system in place that will flag update or revision needs.

Given the long time periods involved in closure planning, a mining company would benefit from establishing procedures to monitor changes – from external and internal sources – that may affect closure. Besides the obvious need to update the Closure Plan when the company changes its mining plans or introduces technological innovations, planning for closure may need to be revised and updated when changes occur in government regulations, when new stakeholders join the process or when there are changes in the position, the viewpoint or values of stakeholders already engaged in the process, for example.

This guideline consists of six best practices and is designed to show how companies can monitor changes, and how these changes should be reflected in the mine closure planning. The best practices are:

Best Practice 7.1 Update the environmental and social impact assessment
Best Practice 7.2 Monitor regulatory changes that could have an impact on closure objectives
Best Practice 7.3 Keep a mapping of stakeholders up-to-date
Best Practice 7.4 Consider closure objectives when making investments in research and development and innovation management
Best Practice 7.5 Consider closure as part of the information management system
Best Practice 7.6 Take a systematic approach to deal with uncertainties inherent to mine closure planning
Best Practice 7.7 Update the Closure Plan regularly or when appropriate

Best Practice 7.1

Update the environmental and social impact assessment

An assessment of environmental and social impacts is usually conducted as a condition for a new mine to be opened. In the best cases, an impact assessment is used to support informed, evidence-based decisions, to develop alternatives and select those that are most feasible, to prepare effective management plans, and to allow for negotiations with stakeholders. The assessment is not to simply comply with legal formalities.

An environmental impact assessment allows a mining company to ascertain the extension, duration and intensity of environmental

impacts, and to propose, if necessary, project changes to reduce or, where possible, eliminate the negative impacts. However, the assessment takes place prior to the implementation of a project, which makes it fraught with uncertainties. Changes and deviations from the baseline project occur as early as during the deployment phase, and may reveal environmental impacts that the original assessment may have failed to have considered, more severe environmental impacts than originally anticipated or a larger area of influence than was expected. It is natural that changes will occur during the operation of a mine, especially those with a long life, and it may increasingly distance the venture from the project whose impacts were assessed. These are the main reasons to keep the impact assessment up-to-date.

For the sake of planning the closure, it is important to consider two groups of impacts: (1) the soci-oeconomic impacts from closure; and (2) the permanent or irreversible biophysical impacts from the implementation and operation of the mine (that will remain after decommissioning).

Identification and assessment of impacts that result from mine closure (Best Practice 1.4) should be kept current because the socio-economic characteristics of communities under the influence of the mine change over time, in part due to the mining business itself and by broader forces at play. Monitoring of local socio-economic development (Guideline 6), particularly of selected indicators (Best Practice 6.2), can be used to keep impact identification and assessment of its importance up-to-date along with the associated mitigation or offset programs. Monitoring of environmental conditions during the operations phase plays the role of a prior environmental baseline in the environmental impact assessment (Best Practice 1.4 and Figure 5).

Permanent or irreversible impacts require offset or reclamation actions that can be revised as the operation phase progresses, and their effectiveness is evaluated (Best Practice 2.7) as more knowledge is acquired (Best Practice 7.1).

Companies that have an environmental management system that is compliant with the ISO 14001 Standard have tools that make it easier to update the impact assessment. These companies need to keep the survey of environmental aspects and impacts as well as environmental programs up-to-date. However, management systems consider only the aspects and impacts of activities, products and services associated with the operation phase, whereas the closure planning is concerned with the impacts of the decommissioning and post-closure stages.

To learn more:

Heikkinen, P. M.; Noras, P.; Salminen, R. (eds.). 2008. *Mine Closure Handbook*. Geological Survey of Finland, Espoo. See chapter 4, *Environmental Impact Assessment and Risk Assessment in Mine Closure*.

IFC, International Finance Corporation. 2012. Guidance Note 1. *Assessment and Management of Environmental and Social Risks and Impacts*. IFC, Washington.

Spitz, K.; Trudinger, J. 2009. *Mining and the Environment: from Ore to Metal.* CRC Press, London. See Chapter 2, Environmental Impact Assessment.

Best Practice 7.2

Monitor regulatory changes that could have an impact on closure objectives

Regulatory changes on issues relating to the protection of environmental and cultural resources, land use, energy, and climate change, among others, could influence not only the operations of a mine, but its closure. Most companies currently have specialized services (either in-house or outsourced) to keep track of changes in legislation or regulations that might affect their business.

One needs to be aware of changes that may affect closure objectives or certain decommissioning actions. Thus, a new municipal zoning regulation could impose changes on the intended future use of the mining site. Possible changes in public policies on compensation for lost biodiversity may offer opportunities to mining companies that need to reclaim large areas, whereas changes in tax regulations can bring advantages or discourage conservation of natural resources.

As for other matters relating to closure planning, it is appropriate that the person responsible for coordinating the actions at each mine (Best Practice 1.1) has an up-to-date channel of information on regulatory changes underway or contemplated. Availability of relevant information facilitates the assessesment of whether they may have any influence on the closure.

Best Practice 7.3

Keep a mapping of stakeholders up-to-date

Updating the map of all potential stakeholders is a prerequisite of mine closure planning. Throughout the life of the mine, the interest of groups or individuals who follow the activities can converge, diverge and vary widely. The characteristics and impacts of different stages of development of a project may generate distinct demands, concerns and expectations.

In the decommissioning phase, the loss of jobs, decline in economic activity, concern with effectiveness of rehabilitation and the future use of the former mining area can engage social actors who were absent, for example, in the early stages of the operation. The late stages of operation and the decommissioning phase pose risks and opportunities of a different nature compared to the early stages. Best Practice 3.1 dealt with the identification of relevant stakeholders for the mine closure

planning process. Appendix II provides a list of key questions that can help both the initial identification of stakeholders and the update of this information.

The mapping of stakeholders should be carefully updated whenever there are any significant change or modification in the project, social conditions, and social programs and projects conducted by the company. This recommendation becomes more important when the mine closure date approaches. The update of stakeholders mapping can be easier if it has been a practice adopted by the company over the life of the mine, with systematic and accessible historical records.

A number of techniques are available to adequately perform this mapping. It is always important to consider the various interests and stances of actors in the community, policy-makers, beneficiaries of socio-environmental programs conducted by the company, employees, local suppliers, and land owners. Preparing a stakeholders matrix that includes institutions, names of leaders, addresses, and contacts details will be extremely useful

To learn more:

Anglo American. 2012. *Socio-Economic Assessment Toolbox Version* 3. See Tool 2B: Developing a Stakeholder Engagement Plan.

IFC, International Finance Corporation. 2007. *Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*. IFC, Washington.

Best Practice 7.4

Consider closure objectives when making investments in research and development and innovation management

Many changes that occur throughout the operational phase of a mine are associated with investments and technological innovations. Innovation – generally defined as production, adoption, assimilation, or use of a novelty that generates economic or social value – can be found in many mining companies, and the development and adoption of innovations can be a managed process in order to support achievement of closure objectives.

The innovation development or adoption process can be managed so as to facilitate meeting closure objectives.

As tailings contained in dams is one of the main factors that hinder and raise the costs of closing a mine, innovations in this area have produced useful solutions, in particular when they have contributed to reducing the amount of waste, as in the cases of:

1. reuse of stored tailings for ore reprocessing and reclamation, thus generating new tailings, but to a lesser volume;

2. alternative economic use – tailings that are currently generated or stored are transformed into a useful product; and

3. improvements in ore processing, thus enhancing recovery and reducing the amount of tailings to be disposed.

Historically, mining companies have learned to mine metal ores with increasingly lower grades of ore, thus making it possible to mine some

tailings dumps. The mining of tailings ponds can facilitate closure and even extend the life of a mine, but it entails updating the closure plan.

Methods for the disposal of tailings in paste used in underground mines, make it possible to stake the tailings in piles instead of building dams to store the tailings. However, in a number of wet tropical regions this technique is not yet used on an industrial scale, due to concerns relating to the behavior of these piles under intense rainfall. In any event, when it is possible to avoid using dams for tailings disposal, both the closure (Best Practice 1.3) and environmental approval processes are streamlined.

Other opportunities for innovation that makes closure easier are related, for example, to the disposal of tailings or waste in areas already mined or exhausted pits, the reuse of waste, and the improvement of rehabilitation practices, in particular the re-introduction of native species on reclaimed lands.

As in the case of several other practices described in this Guide, for innovation management to be used for the purpose of leaving a positive legacy after closure of a mine, the commitment of top management is key, with an integration of closure considerations into strategic planning (Best Practice 1.1) and the multiple levels of decision-making.

CASE: TRANSFORMATION OF WASTE INTO A BY-PRODUCT AT THE MORRO AGUDO MINE

At the Morro Agudo mine, located in Paracatu, State of Minas Gerais, a flotation circuit processes sulfide zinc and lead ore, which generates waste with high concentration of calcite. In 2007, Votorantim Metais launched the "Zero Waste" project, designed to transform waste into soil amendments.

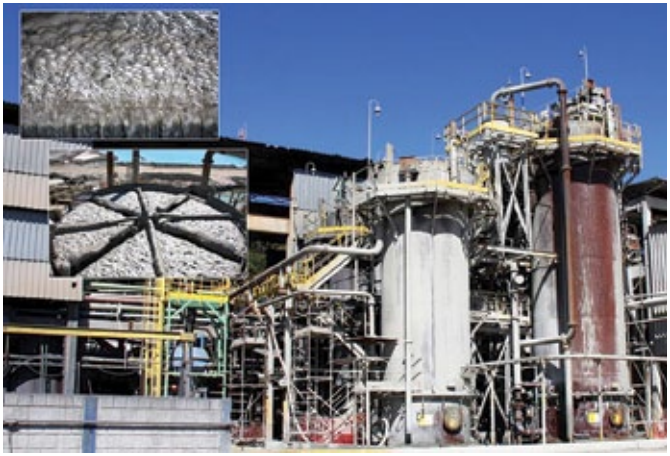
Improvements in the ore treatment facilities have led to higher metal recovery along with the reprocessing of tailings stored in dumps (formed by perimeter dikes, but known as "dams"), called industrial limestone powder. The result was the creation of a new marketable waste, renamed agricultural lime powder, a term that is extensively used in the market.

In order to be marketed, soil acidity amendments must meet the maximum metal concentration specifications – 20 ppm of cadmium and 1,000 ppm of lead in its composition –, according to a 2010 Directive by the Ministry of Agriculture which sets maximum limits for toxic heavy metals allowed in acidity correction amendments. Sold under the trade name of Zincal, Votorantim's product also contains zinc, which is a micronutrient.

Out of the annual production of 880 thousand tons of waste – now a byproduct – the company sold 550 thousand tons in 2011, i.e., revenues of approximately R$ 7 million. As a result of this initiative, construction of new waste dump was avoided, at an estimated savings of over R$ 20 million (approximately US$ 10 million). A blend of reprocessed industrial limestone powder and ground ore fed to the processing plant will make it possible to eliminate the stocks of this obsolete waste.

Thus, innovations in the ore treatment process yielded cleaner production procedures and facilitated closure as it made it possible to completely remove at least one tailings pond and prevented establishment of another.

Aerial view of the tailings pond, the industrial facilities and the headframe of the underground mine.



View of the flotation plant, where incremental innovations were necessary to improve quality control.

Sources: Votorantim Metais, Brasil Mineral no. 318 (June 2012) and DNPM, Sumário Mineral 2012

Best Practice 7.5

Consider closure as part of the information management system

Many mining companies have information management systems designed to meet mine operation or mine planning requirements. Such systems may include information that is relevant to plan for closure and the updating of existing plans. The closure planning team can identify relevant information in these systems and databases. However, instead of being a mere user of data collected and stored for other purposes, the team responsible for closure planning should influence information management at the company so that corporate systems include information that is both necessary and relevant for closure.

In order to mainstream closure as an integral part topic into the information management system, the staff involved with closure planning should help develop repositories by selecting relevant information. This initiative helps mainstream closure into the company's strategic planning (Best Practice 1.1). Given that closure planning requires a large amount of information from assessments and activities developed during the mine operation stage, managing information is important for assessing its application to closure planning and decide what to do with the information acquired during the life of the mine.

The information management system relating to closure planning includes four main steps.

1. Establishing the need for information. It is essential to understand the need for information and its source (either external or internal to the company). For example, before requesting a resources and reserves evaluation report, the staff responsible for closure planning should be aware that this document will provide information that can define the life of the mine and the likely date of its closure. Requesting information without

knowing its utility for closure planning generates unnecessary costs and efforts.

2. Acquisition. These are activities related to the collection of predefined information. The main activities related to collecting data and information of interest to closure planning can be: face-to-face or telephone interviews, corporate reports and documents, meetings, informal conversations, etc.

3. Processing. This covers processing the information collected by adapting its format for its intended use. Information processing includes classification and storage in appropriate repositories. Information classification concerning closure planning can be chronological, subject-based, alphabetical, by level of confidentiality, multiple, etc. For closure purposes, the chronological mode can be useful as it provides insight into how studies, projects and assessments evolved. Storage includes the selection of appropriate repositories to make access easier. It should be pointed out that storage only applies when a purpose is stated, as information is often time-sensitive and becomes useless when not used in a timely manner.

4. Distribution and presentation. This involves establishing the best methodology to present information relating to closure planning in order to provide access to internal and external users, while taking into account restrictions to be placed on various user groups. Certain information may be subject to an active dissemination program using multiple channels.

Although information management is a role for specialists, users play a central role in the choice of content, formats and the very organization of an information management system.

Typical documents in mining companies that can be used to record information relating to closure include, but are not limited to:

- resources and reserves evaluation reports;
- land rehabilitation plans, environmental liability investigation reports, and remediation plans;
- environmental impact studies, environmental management or control plans, environmental monitoring reports, environmental performance reports;
- audit reports (management systems, compliance, dams, etc.) and records from environmental, health and safety or integrated management systems;
- maps and plans, including those that capture changes in pits, dumps and other structures;
- minutes of public hearings;
- minutes and records of meetings with the community and government organizations;
- records of complaints and grievances; and
- minutes of meetings relating to closure planning, which can document assumptions, decisions and their rationale.

An excessive amount of information can hinder rather than facilitate its use. The purpose of information management and document management is to facilitate access and use of relevant and pertinent information. Document analysis is intended to give a convenient format to information contained with a view to making queries and indexing easier.

Best Practice 7.6

Take a systematic approach to deal with uncertainties inherent to mine closure planning

Planning the opening of a mine is known to involve a number of uncertainties. Among other variables, the future behavior of prices for metals and minerals cannot be known, and not even the mine to be exploited is well known. As far as closure is concerned, however, the issue is more complex, given that the planning horizon can be in the order of several decades.

Uncertainties are inherent to any long-term perspective, and mine closure planning can be understood as an uncertainty management process. Ignoring or underestimating uncertainties could result in ineffective and/or inefficient closure actions (such as decommissioning and reclamation programs and social programs), i.e., actions that fail to achieve the expected objectives and/or call for excessive financial, human and other resources.

Regularly updating the Closure Plan (Guideline 7) is one of the ways to tackle uncertainties, but in itself it is not sufficient to address this issue adequately. Taking into consideration various closure scenarios (Best Practice 1.6) helps a company to prepare to act in cases of deviation from full compliance with the mining plan, and to develop contingency plans (Best Practice 4.3). In addition to these initiatives, however, as closure planning is an ongoing decision-making process, uncertainties should systematically addressed through some structured approach that supports the decision-maker to assess their level of confidence (or lack thereof) in the information and knowledge available.

Appendix VI describes a structured approach specifically designed to reflect uncertainties in the mine closure planning. Unlike other approaches that assume that every uncertainty can be reduced by increasing information and enhancing knowledge, the scheme is

based on the premise that uncertainty has different causes (Table 9), which leads to different strategies for dealing with uncertainties of various sorts.

Thus, successful mine closure actions depend, among other factors, on properly dealing with three situations:

1. incomplete knowledge;
2. variability of natural events and social processes, and their resulting unpredictability; and
3. ambiguity that is reflected in diverging understandings of relevant issues.

Table 9: Main causes of uncertainty in planning

Cause	Description
Variability or unpredictability	Characteristic that is inherent to a complex phenomenon
Incomplete knowledge	Missing information Abundance or excessive information Conflicting evidence about a phenomenon Errors of measurement Groundless information Lack of understanding of the process or phenomenon in question
Multiple perceptions of the situation in question	Multiple and conflicting perceptions of the process or phenomenon in question Differences in values and beliefs between those involved in the articulation and analysis of the situation Different judgments on the seriousness of the situation

To learn more:

Brugnach, M. et al. 2008. Toward a relational concept of uncertainty: about knowing too little, knowing too differently and accepting not to know. *Ecology and Society* 13(2), article 30, p. 1-16.

Neri, A.C. 2013. *Tratamento de incertezas no planejamento de fechamento de mina*. PhD. Thesis. Escola Politécnica da Universidade de São Paulo.

Walker, W.E. et al. 2003. Defining uncertainty. A conceptual basis for uncertainty management in model-based decision support. *Integrated Assessment* 4: 5-17.

Zimmermann, H. 2000. An application-oriented view of modeling uncertainty. *European Journal of Operational Research*. 122: 190-198.

Best Practice 7.7

Update the Closure Plan regularly or when appropriate

The best practice guides are unanimous about the importance of revising and updating the Closure Plan during the life of a mine. Some guides postulate that updating a Mine Closure Plan does not necessarily imply significant rework of the original plan, unless major changes have occurred, but the Plan should provide confirmation of the current status of the closure planning (e.g., by incorporating new data or changes related to closure) and reflect the ongoing nature of progress and planning of closure efforts.

These updates should take into account relevant changes during the operation phase, such as a reevaluation of reserves, changes to corporate policies or guidelines, technological changes that might have implications for closure objectives, variations in costs and their repercussions on the calculation of fund provisions, new legal requirements, changes

in the relationship with the community, increased awareness of the environmental impacts caused by the mining operation, new risk scenarios. Of course, a revision may be partial – an update of only those topics that have undergone significant change.

Changes may therefore come from inside and from outside the company. To keep track of external changes, it is recommended that the company establish a mechanism that: tracks complaints and conflict management (Best Practice 3.4), monitors the socio-economic development of the community or region, including changes in land use (Best Practices 6.1 and 6.2), updates the assessment of environmental and social impacts (Best Practice 7.1), follows regulatory changes (Best Practice 7.2), and keeps the mapping of stakeholders up-to-date (Best Practice 7.3). With regard to internal changes, those in charge of closure planning need to become involved, with other divisions of the company, in making decisions that could affect the company's ability to achieve closure objectives from the perspective of strategic planning (Best Practice 1.1), change management (Best Practice 7.4), and information (Best Practice 7.5) while considering the inherent uncertainties (Best Practice 7.6).

The frequency of updates to the Closure Plan is at the discretion of the individual company. A timeframe that is often recommended is three to five years. However, more important than establishing the frequency of such updates is integrating closure planning into internal corporate processes. Thus, each company will use the frequency that suits it best. At the same time, there are recommendations for an annual review of costs and provisions, to improve practical integration with the administrative and financial affairs of a company.

Appendix VI provides a list of questions that can help identify the need to update the Closure Plan.

For every revision, the plan is expected to become more detailed, as it will be based on better-founded knowledge and perceptions shared

among the main stakeholders (Best Practice 7.6), i.e., based much more on evidence than on assumptions.

Most mining companies hire consultants to prepare closure plans. To obtain good results, it is essential that the plan be perceived as the **document that captures the content of the closure planning process**, i.e., the means, not the end.

Two actions contribute to the quality and usefulness of the plan:

1. Designating a corporate team to closely monitor and work with the consultants in preparing or updating a closure plan; and
2. Hire an external review (or audit) to analyse each successive version of the plan.

To learn more:

ICMM, International Council on Mining & Metals. 2008. *Planning for Integrated Mine Closure*: Toolkit. ICMM, London. See Tool 5, Knowledge Platform Mapping and Tool 11, Change Management Worksheet.

Western Australia. 2011. *Guidelines for Preparing Mine Closure Plans*. Department of Mines and Petroleum, Environmental Protection Authority.

APPENDICES

APPENDIX I

REFERENCE LIST OF POTENCIAL STAKEHOLDERS

Community

- residents of surrounding areas
- landowners in the surrounding areas
- associations of local residents
- nearby rural areas
- nearby urban areas
- neighboring municipalities

Civil society organizations

- local, national or international NGOs operating in the following domains;
  - education
  - gender relations and women's rights
  - human rights
  - environment
  - health care
  - labor and income
  - agriculture
  - solidarity economy
  - STD/AIDS
  - urban issues
  - social assistance
  - public security
  - sex discrimination
  - consumer relations
  - sports
- charities
- churches or religious organizations

Vunerable social groups

- traditional populations
- indigenous peoples
- ethnic minorities
- elderly population
- children and young people
- people with disabilities
- small local producers
- small regional producers

Social movements

- movements for land reform
- movements for urban reform
- housing movements

Government organizations

- local governments
- municipal departments
- state government
- state departments
- federal agencies
- federal regulatory agencies
- state regulatory agencies

Civil society organizations

- municipal assemblies
- municipal development agencies or forums
- regional development agencies or forums
- intercity consortiums
- municipal councils
- state councils
- river basin committees

Professional organizations

- professional bodies and associations
- trade unions

Industry and trade organizations

- commercial associations
- customers
- suppliers
- other mining companies

individuals or groups with a special interest

- with an interest in post-mining uses
- with an interest in the company (partners and shareholders)
- media
- landowners
- Surface right holders

employees/associates

- board of directors
- advisory board
- managements
- shareholders
- lawyers
- health, safety and environment employees
- workers
- retirees
- families of employees
- personnel and human development department
- operational workers
- technical workers

Source: adapted from ICMM, International Council on Mining & Metals. 2012. Desarrollo Comunitario. Kit de Herramientas. ICMM, Londres.

APPENDIX II

KEY QUESTIONS FOR IDENTIFYING AND REVIEWING RELEVANT STAKEHOLDERS FOR CLOSURE

This list of questions can be used in conjunction with the reference list of stakeholders (Appendix I) to help identify relevant stakeholders for closure planning and sharpen attention on closure. These are questions of a general nature, which should be broken down into more detailed questions that are intended to apply to specific mines.

Key Questions
Who will be adversely affected by the mine being closed?
Who can benefit from the mine being closed?
Who are the most vulnerable groups in a mine closure scenario?
Who are the beneficiaries of the company's current social programs (for active mines)
What is the geographic scope of the impacts associated with the closure (local, regional)?
Where do the employees and contractors live?
What are the organizations representing the workers?
Who are the company's direct and indirect suppliers?
Which groups or individuals could help to enhance closure objective setting?
Who will be responsible for implementing measures to mitigate the adverse social impacts?
Which groups or individuals may be involved in the environmental and social monitoring during the post-closure phase?
Who will take part in the decision-making process?

APPENDIX III

CONSULTATION MATRIX FOR MINE CLOSURE PLANNING

The plan for conducting consultations with stakeholders should take into account the interests and concerns according of the various target audiences. The degree of interest should have been reviewed during the previous stakeholder mapping stage. The selection of consultation methods and tools should take into consideration the diversity of interests and issues of concern.

Degree of interest regarding closure impacts	Level of engagement	Examples of consultation methods and tools	Potential stakeholders
Very high	Participation in the groups responsible for the decision-making process	External and internal advisory committees, visits to the area	• Employees • Local government • NGOs operating in the local community
High	Participation in substantive debate on relevant aspects relating to closure	Workshops, public meetings	• Employees and suppliers • Local government • NGOs operating in the local community • Community leaders
Medium	Follow-up actions undertaken by the company, passive collaboration in identifying the community's needs, problems and opportunities	Newsletters, press releases, interviews	• Local and regional business leaders and entrepreneurs • State regulators • NGOs with expertise in issues indirectly related to local issues
Low	Follow-up of actions pursued and general information relating to closure	Press releases, newsletters, webpages	• NGOs without a significant footprint in the area • Government agencies without direct involvement in the theme • Neighboring municipalities with no relations with the mining business

APPENDIX IV

ASPECTS TO BE CONSIDERED IN A LAYOFF PLAN

Alternative solutions to layoff

- Layoffs should be the last resort, and considered only after alternatives to the loss of jobs have been exhausted.
- As alternatives to layoffs, the following should be considered: the internal transfer of workers to other companies that may be related to the company that owns the mine, hiring by similar companies, and the possibility of workers accepting retirement packages.
- In the assessment of alternatives to layoff, it is important to consider any suggestions and proposals made by stakeholders during the consultation process.

Information on the economic environment

- Decisions relating to the development and implementation of a resignation plan should consider the relevant legal and economic aspects of the environment where the mining business operates.
- Knowledge of the local and regional economic context should support the assessment of options to create new jobs or to start new businesses.
- The degree of dependence of the local economy on the mining operation should be known; this information could support the economic impact assessment that looks at the economic implications of losing mining jobs on the local economy.
- One should be aware of and assess the major trends in the industry, in particular projections of growth, employment, level of investment, and wages.

Labor legislation

- Current labor laws should be considered not only in relation to the rights associated to payments and compensation due, but also in relation to collective agreements.
- The layoff plan should take into account relevant international standards and conventions.

Scope of layoffs

- One should evaluate the scope of layoffs considering the number of jobs to be terminated.
- It is also important to know the profile of the workforce that will be laid off in terms of gender, qualification, types of employment agreement..
- When evaluating the scope of layoffs, it is important to consider the entire supply chain that will be affected.

Standards and procedures

- One should consider the possibility of conducting one-to-one interviews with workers whenever possible.
- A layoff schedule should be in place.
- A mechanism for the submission of complaints and grievances should be put in place. This mechanism is not a replacement to legally established mechanisms.

Countervailing measures and additional assistance to laid-off workers

- Design training plans for finding a new job.
- Programs to assist and encourage the creation of micro businesses.
- Consider the need for temporary economic assistance extended to the laid-off worker's family, depending on the socioeconomic environment where the mining industry operates.

Communication and consultation with workers

- Communications and consultation are key steps in the development and implementation of a layoff plan; in addition to the workers directly affected, these steps should engage the professional bodies that represent the workers and local authorities.
- A communications and consultation plan should be prepared as soon as practicable.
- Information on the dismissal process should be clear and accessible.
- The suggestions and proposals made during the consultation stage should be considered when drafting the dismissal plan.
- Set up a committee to follow the dismissal process which includes, in addition to the workers directly affected, representatives from professional bodies and local government authorities.

Monitoring

- Indicators that can be monitored after the termination process should be selected, such as the percentage of workers who find new jobs in the local or regional job market.
- Agree on the frequency and duration of monitoring.

Source: adapted from IFC (2005)

APPENDIX V

CLOSURE PLAN CONTENTS

The Mine Closure Plan is a document that brings together the primary information and guidelines that a company can use when it implements its closure actions. This appendix list its basic content, which can be changed depending on the complexity of the mine.

Basic components of a closure plan:

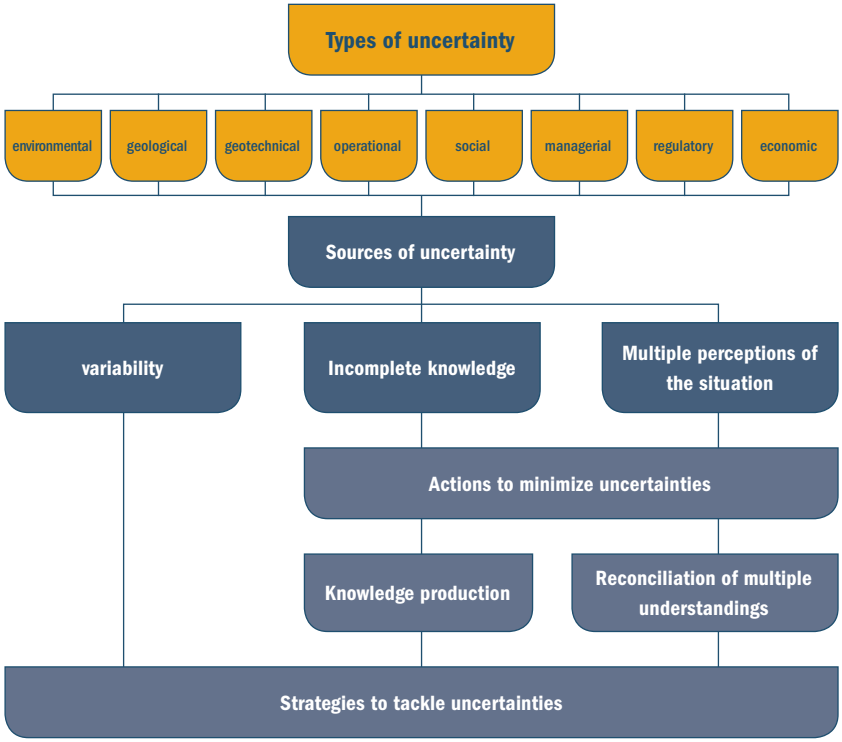
1. Definition of key issues and closure objectives (including post-closure land use)
2. Profile of project
3. Profile of the area
4. External stakeholder engagement plan
5. Internal stakeholder engagement plan
6. Layoff plan
7. Communications plan
8. External and internal stakeholder consultation plan
9. Mechanism for the submission of complaints and grievances
10. Social and environmental programs
11. Decommissioning program
12. Risk assessment
13. Assessment of closure outcomes (setting criteria for closure)
14. Post-closure management
15. Closure costs and fund provision
16. Physical and financial schedule
17. Relinquishment
18. Contingency plan
19. Monitoring and maintenance plan

APPENDIX VI

APPROACH FOR DEALING WITH UNCERTAINTIES IN MINE CLOSURE PLANNING

The approach to consistently dealing with uncertainties in mine closure planning involves three steps, which are outlined in Figure VI-1.

Figure VI-1: Guiding principles for dealing with uncertainties in mine closure planning



The steps are as follows:

1. **Identifying uncertainty types.** Every planning process involves uncertainties. Acknowledging and classifying them is the first step to establish ways of dealing with them by mainstreaming them into the decision-making process and in company divisions. Eight types of uncertainties that are relevant to mine closure planning are considered,and are described in Table VI-1.

Table VI-1: Types of uncertainties involved in mine closure planning

Types of uncertainty	Description
Geological uncertainties	Associated to the imperfect knowledge of a mineral deposit
Geotechnical uncertainties	Associated with the geotechnical behavior of soils and rocks
Environmental uncertainties	Associated to the knowledge of environmental processes affected by the project
Social uncertainties	Associated with the community's demands and expectations
Technological or operational uncertainties	Associated to the performance of technological processes in the production and mitigation of adverse environmental impacts
Managerial uncertainties	Related to future corporate strategies and priorities
Economic uncertainties	Associated to changes in mineral prices and closure costs
Regulatory uncertainties	Associated with changes in regulations and governmental requirements

2. **Classification of causes of uncertainty.** Following the typology of uncertainties in Table VI-1, their causes are identified (see Table 9 in the main text) in order to identify appropriate actions and strategies to deal with them. Uncertainties arising from variability are not amenable to reduction through investments in research or information collection. Similarly, when the cause of uncertainty is associated with different perceptions by groups inside or outside the mining company, production of knowledge does little to reduce uncertainty. This classification is crucial to decide how to deal with situations of uncertainty.

3. **Knowing the uncertainties and their causes, actions to minimize those that are amenable to reduction can be selected (Table VI-2).** The identification of the causes of uncertainties will allow for the identification of uncertainties arising from variability – over which the company has no control or significant influence – from those associated to incomplete knowledge and those arising from multiple perceptions – for which actions to minimize uncertainty can be envisioned, whether through knowledge production or through integration of different perceptions of the situation at issue. Actions to minimize uncertainties arising from incomplete knowledge require knowledge production (e.g. scientific or technological research, collection and analysis of information, collection and review of evidence). Tool 5– mapping the knowledge platform of ICMM (2008) provides an extremely useful classification for tracking the progress and enhancing the knowledge needed to plan for the closure.

Uncertainties related to multiple perceptions, in turn, call for actions to reconcile them – for example, through joint fact-finding efforts.

In both cases (development of knowledge or of common perceptions), the company will want to assess the costs and benefits of the individual potential actions geared at reducing uncertainties.

On the other hand, uncertainties arising from variability cannot be reduced. Therefore, variability imposes acceptance of the fact that it is not possible to make deterministic predictions about this phenomenon, and that conducting more research and developing more dialogue with stakeholders will not change the situation in the near future. Hence the company needs to prepare for possible changes and their consequences by developing scenarios (Chapter 7) and contingency plans (Best Practice 4.3) and by considering alternative scenarios for future land use. Situations that may fall into this category include fluctuations in commodity prices, new regulatory requirements, and demands by the community, among others.

Table VI-2: Examples of actions to reduce uncertainty in mine closure planning

Type of uncertainty	Examples of actions to reduce uncertainties arising from incomplete knowledge	Examples of actions to reduce uncertainties arising from multiple perceptions
Environmental	• Develop applied research or conduct experiments during the operation phase with a view to producing knowledge focused on decision-making related to closure (e.g. detailing the hydrogeological model to establish the time required to fill a pit after pumping ceases). • The actions to achieve this are related to the following practices: » Develop or update an accurate social and environmental baseline (Best Practice 2.4) » Undertake progressive reclamation of degraded areas (Best Practice 2.7)	• Discuss the results of environmental programs with internal and external stakeholders • Develop joint fact finding actions with stakeholders. • The actions to achieve this are related to the following practices: » Share information on the closure process (Best Practice 3.2) » Consult with external and internal stakeholders (Best Practice 3.3)
Geological	• Identify gaps in knowledge of the geological model and its impact on the assessment of resources and reserves. • The actions to achieve this are related to the following practices: » Best Practice 1.6 – Consider various closure scenarios	• Information exchange and discussion sessions between the mine closure planning team and the mine planning team in order to build closure scenarios. • The actions to achieve this are related to the following practices: » Consult with external and internal stakeholders (Best Practice 3.3)

Type of uncertainty	Examples of actions to reduce uncertainties arising from incomplete knowledge	Examples of actions to reduce uncertainties arising from multiple perceptions
Geotechnical	• Update geotechnical stability studies for waste rock dumps as they are built and once the operation phase ceases while maintaining "as built" documentation. • The actions to achieve this are related to the following practices: » Consider closure objectives when developing the mining project (Best Practice 1.3) » Bring together technical documentation on the mine (Best Practice 2.1)	• Discussion sessions between the mine closure planning team and the designers of geotechnical structures. • The actions to achieve this are related to the following practices: » Consult with external and internal stakeholders (Best Practice 3.3)
Technological or operational	• Assess the performance of environmental and social programs and, based on the results, make adjustments and improvements (e.g. procedures for reclamation of degraded areas, programs to support economic diversification in the municipality). • The actions to achieve this are related to the following practices: » Undertake progressive reclamation of degraded areas (Best Practice 2.7) » Assess and manage risks involved in the closure actions and programs (Best Practice 4.5) » Update the environmental and social impact assessment (Best Practice 7.1)	• Information exchange sessions between the mine closure planning team and corporate divisions in charge of tasks such as environmental and social programs implementation and investments in technological development (e.g. new approaches to treatment or enhanced recovery in ore processing plant). • The actions to achieve this are related to the following practices: » Consult with external and internal stakeholders (Best Practice 3.3) » Consider closure objectives when making investments in research and development and innovation management (Best Practice 7.4)

Type of uncertainty	Examples of actions to reduce uncertainties arising from incomplete knowledge	Examples of actions to reduce uncertainties arising from multiple perceptions
Social	• Consult with the community about its expectations after mine closure. • The actions to achieve this are related to the following practices: » Identify stakeholders and keep their mapping up-to-date (Best Practices 3.1 and 7.3) » Analyse the local and regional socio-economic context (Best Practice 6.1) » Monitor development and indicators of living standards (Best Practice 6.2)	• Promote company-community integration through forums or other mechanisms to discuss various views regarding issues relating to mine closure. • The actions to achieve this are related to the following practices: » Share information on the closure process (Best Practice 3.2) » Consult with external and internal stakeholders (Best Practice 3.3) » Establish a mechanism for the submission of complaints and managing conflicts (Best Practice 3.4)
Regulatory	• Keep the repertoire of legal requirements relating to closure up-to-date (e.g. similar to the update of regulations for an environmental or occupational health and safety system). • The actions to achieve this are related to the following practices: » Monitor regulatory changes that could have an impact on closure objectives (Best Practice 7.2)	• Regularly report on the results of reclamation practices to regulatory authorities and other stakeholders. • The actions to achieve this are related to the following practices: » Share information on the closure process (Best Practice 3.2)

Type of uncertainty	Examples of actions to reduce uncertainties arising from incomplete knowledge	Examples of actions to reduce uncertainties arising from multiple perceptions
Managerial	• The record and documentation of the main obligations relating to closure and their reasons and justifications is a form of protection • against management changes that could mean reduced • commitment to closure objectives. Such actions help to minimize organizational memory loss. • The actions to achieve this are related to the following practices: » Consider closure planning as part of the company's strategic planning (Best Practice 1.1) » Bring together technical documentation on the mine (Best Practice 2.1) » Document results of planning in a Closure Plan (Best Practice 4.1) » Consider closure as part of the information management system (Best Practice 7.5) » Update the Closure Plan regularly or when appropriate (Best Practice 7.7)	• Actions that contribute to reducing uncertainties arising from incomplete knowledge of managerial uncertainties also help • to reduce gaps in understanding that might occur across various teams in the company. Developing and implementing operational procedures related to planning and closure also contributes to this end. • Other actions to achieve this are related to the following practices: » Share information on the closure process (Best Practice 3.2) » Consult with external and internal stakeholders (Best Practice 3.3) » Update the environmental and social impact assessment (Best Practice 7.1)

Type of uncertainty	Examples of actions to reduce uncertainties arising from incomplete knowledge	Examples of actions to reduce uncertainties arising from multiple perceptions
Economic	• Accuracy of closure cost estimations can be improved through actions such as collecting data on the costs of reclamation activities in other mines, and detailing the environmental and social programs. • The actions to achieve this are related to the following practices: » Estimate the costs of closure-related programs (Best Practice 5.1) » Regularly update cost estimations for closure-related programs (Best Practice 5.2) » Make fund provisions for closure (Best Practice 5.3) » Update the Closure Plan regularly or when appropriate (Best Practice 7.7)	• The definition of costs associated with closure vary across companies, as well as the allocation of costs between different divisions within the company. Establishing internal rules contributes to making understanding consistent and allocating responsibilities. Thus, engaging different teams in the estimation of closure costs and the calculation of financial provision contributes to making understanding consistent. • The actions to achieve this are related to the following practices: » Consult with external and internal stakeholders (Best Practice 3.3)

APPENDIX VII

QUESTIONS TO UPDATE THE MINE CLOSURE PLAN

The need to update the Closure Plan may result from changes within or outside the company. This Appendix provides an illustrative list of questions to help establish whether relevant changes have occurred that may warrant updating the Closure Plan. It is a qualitative assessment of all actual changes that can feed into the decision-making process on updating the Closure Plan while taking into account the need for regular revision as per corporate policies.

Questions
Have there been changes to the mining plan (e.g. mining process, scale, levels)?
Has there been a reevaluation of reserves that resulted in the life of the mine being expanded?
Have new facilities been added to mine?
Have there been changes to corporate guidelines or strategic directions that might have an impact on closure?
Have new environmental risks (e.g. acid rock drainage, lost topsoil) been identified?
Have new social risks (e.g. artisanal miners, social conflicts) been identified?
Have there been changes to laws and regulations that might affect closure objectives or obligations of the company?
Have there been changes to land uses in the vicinity of the mine?
Has the rate of rehabilittion of degraded areas been slower or faster than planned?
Have there been nonconformities or design changes that reflect failures in the implementation or operation (e.g. leakage in tailings dam, angles of stability of waste rock dumps)?

Questions
Has climate change been observed or forecast that could pose new risks or affect the performance of environmental and social programs (e.g. increased rainfall intensity, longer dry spells)?
Has the community's profile, including demographics, economic activity (e.g. implementation of new projects) changed in ways that were not forecast?
Have social organizations (e.g. NGOs, associations) submitted new demands or have they expanded their agenda for discussion?
Have monitoring programs detected impacts of greater magnitude, duration or area of influence than those reflected in the environmental impact study?

GLOSSARY

Accounting Provision — Funds acknowledged as costs in any given fiscal year due to the expectation or certainty of a future liability. The provision does not imply availability of funds, only its bookkeeping, and should not to be confused with the collateral, which is enforceable by third parties. The regulation of capital markets in some countries requires reclamation costs to be accrued and reported to the market.

Acid drainage — A process that is triggered when sulphide minerals come in contact with air and water, thus creating an acidic liquid solution.

Collateral — An instrument employed in various commercial domains that guarantee the fulfilment of a contractual obligation. For mine closure, it allows public bodies to carry out programs scheduled under the Closure Plan in case of default by the company. Various financial instruments can be accepted as collateral, as surety bond, bank guarantee, or blocked reserve account funds, depending on the regulations of the relevant jurisdiction.

Conflict management — Management that is directly concerned with situations where conflict or incompatibility of interests occur between individuals or communities in relation to a project or operation. Conflict management employs various techniques, practices and processes that may involve consultation, mediation and negotiation to achieve an agreement.

Community — A social group or set of social groups that occupy a geographically defined area. The members of the social group or set of social groups have relations of reciprocity, shared values and common cultural and historical heritage and feature mainly primary social contacts.

Direct labor Jobs created by the company and listed on its payroll.

Ecosystem services Benefits that society derives from ecosystems. The services are usually classified as provisioning services (water, biological resources, fuel, food), regulation services (flood, climate, water quality, disease vectors), cultural services (recreational, educational, spiritual, enjoyment), and support services (primary production, nutrient cycling, pedogenesis, etc.).

Employability Ability of a worker to remain in or enter the labor market, represented by a combination of skills and abilities.

Empowerment The definition of empowerment is close to the concept of autonomy as it relates to the ability of individuals or groups to decide on issues that concern them. Empowering is the process by which individuals, organizations and communities gain the ability to negotiate, influence, act and make decisions on issues that affect their lives. More broadly, empowerment refers to strengthening of freedom of choice and action, with an assignment of responsibility for making decisions.

Host community A group of people who live or work in the same location (e.g. a neighborhood, a village, a town) where the project is in operation, will be deployed or decommissioned. The community may include members who have temporarily moved to other locations.

Indirect labor This comprises the employees of companies hired to work in the operation, i.e., it refers to the jobs listed on the payroll of hired contractors to perform contracts, indirect workers working for suppliers of the operation or suppliers of contractors or subcontractors.

Innovation Production, adoption, assimilation or use of a novel approach that generates economic or social value.

Net gain (in terms of biodiversity) Situation in which the balance between the degraded areas and reclaimed and conserved areas is positive, i.e., by the end of the post-closure phase the operations performed at the mine will have contributed to a net gain for biodiversity protection.

Organizational learning Increased capacity for effective action by a company or organization. Learning can take place at the individual, social, collective or organizational levels. Long-term processes, such as mine closure planning, cannot depend on the learning of an individual leader, team manager or even a group – who will be eventually replaced –, but must be integrated into the organization's culture.

Social capital A concept that refers to the ability of a community to establish bonds of interpersonal trust and cooperative networks, thereby adding actual or potential resources aimed at the production of shared goods.

Social learning A process that emphasizes collaboration among different social actors to manage issues that are of collective interest based on dialogue and critical and creative thinking, taking into consideration the interdependence of actors. Social learning implies a shared perception of a problem without implying that full consensus should be reached. Social learning also implies that the decision-making process is based on reciprocity and commitment among the relevant actors, thus resulting in a collaborative intervention.

Social license The acceptance of a company and its operations by a community, resulting in lower risk of conflicts and negotiated dispute resolution. It does not refer to any governmental clearances, and bears no relationship with the environmental license. This license or social acceptance is always precarious, in that it can be "withdrawn" if trust ceases to exist. Nor does it imply unanimous acceptance by the various groups of the host community.

Stakeholders Stakeholders include all individuals or groups who could be either directly or indirectly affected by a project or operation, either positively or negatively, in addition to those who have an interest or influence on its results. These include local communities, local and regional officials, civil society organizations, political and religious leaders, trade representations, vulnerable social groups, etc.

Stakeholder involvement A broad-based and inclusive process that develops between a mining company and individuals or groups potentially affected either positively or negatively by the project, encompassing an array of participatory activities, methods and approaches, which span the entire life of a project.

Structures In this Guide, structures refers to components of a mine that have been deployed for its operation, such as the pit, underground mine, waste rock dump, tailings dam, leaching dump, etc. These are also called assets.

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IBRAM

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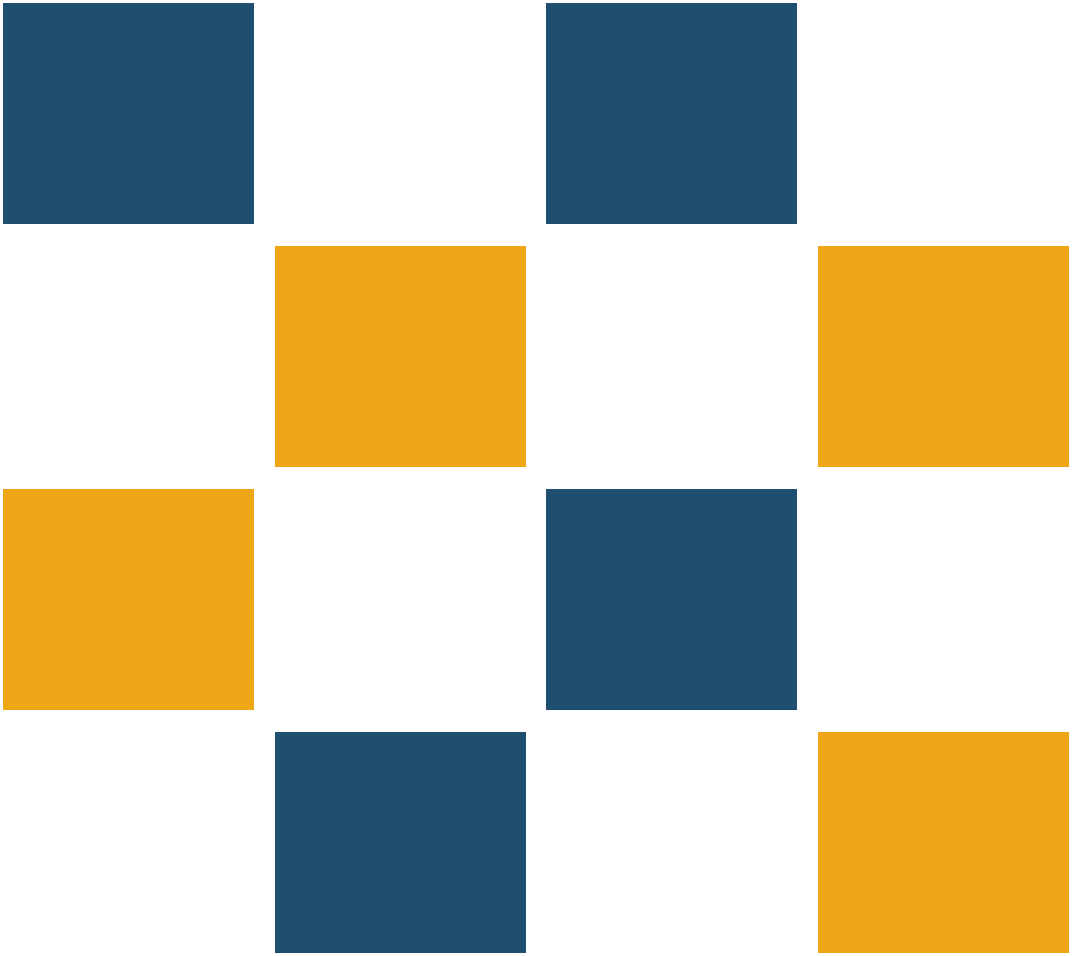

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