MINE CLOSURE

WHY? and HOW?

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IMPORTANCE OF MINING

- **Mining is not merely collecting a mineral from the earth, it is the activity that forms the stepping stone for a country's development and economic success.**

- **Mining has been the foundation of society since the earliest times.**

- **The development of mankind and its standard of living have always essentially depended on the availability of mining products.**

- **Technical progress in the past and today is unthinkable without the raw materials provided by mining.**

MINE CLOSURE : WHAT IS IT ?

IF A MINE IS OPENED, THEN IT IS ALSO TO BE CLOSED AND PUT TO A MEANINGFUL POST MINING LAND-USE.

Mine closure refers to the period of time when the operational stage of a mine is ending or has ended, and the final decommissioning and mine rehabilitation is being undertaken.

Mine closure is a continuous series of activities that begins with pre-planning prior to the project's design and construction and ends with the achievement of long-term site stability and the establishment of a self-sustaining ecosystem.

IMPACTS OF MINING

on LAND

- Land degradation
- Land fragmentation
- Soil disruption
- Soil contamination
- Erosion
- Dusts (radioactive, toxic nuisance)

on WATER

- Groundwater table alteration
- Spring and borehole yield
- River or surface water diversion
- Turbidity Contamination of rivers
- Acid Rock Drainage
- Tailings

on AIR

- Carbon oxides
- Sulphur oxides, Nitrogen oxides
- Methane
- CFOs
- Dusts (radioactive, toxic nuisance)

IMPACTS OF MINING ON LAND

Although mining activities are usually short term phenomena and an intermediate use of land, they are liable to leave long lasting impacts on landscape, ecology and on the mind set of local inhabitants. Damages caused to land by different activities of mining are due to:

- **land acquisition, vacating and shifting of people**
- **clearing of vegetation cover**
- **topsoil removal and excavation**
- **disrupting surface and ground water resources (also pumping out mine water)**
- **haulage, storage and transportation of excavated material**
- **treatment (physical and chemical) use, and**
- **to subsidence of land and mine fires**

The snow-balling effect of mining continues up to a much larger area over a greater period of time.

PREMATURE MINE CLOSURE

Almost 70 % of the mines had unexpected and unplanned closures. They have closed for reasons other than exhaustion or depletion of reserves like:

- **economic, like low commodity prices or high costs**
- **geological, such as an unanticipated decrease in grade or size of the ore body**
- **technical, such as adverse geotechnical conditions or mechanical/equipment failure**
- **regulatory, due to safety or environmental breaches**
- **policy changes, which occur from time-to-time, particularly when governments change**
- **social or community pressures, particularly from non-government organisations**
- **closure of downstream industry or markets**

Poorly closed and derelict (abandoned) mines provide a difficult legacy issue for governments, communities and minerals companies and, ultimately, tarnish the mining industry as a whole.

WHY MINE CLOSURE IS REQUIRED

MINING MAY CAUSE ACID MINE DRAINAGE FORMATION:

- Waste rock and tailings contain sulfide minerals such a pyrite (FeS_2).
- When exposed to air and water, will oxidize and release iron and sulfate into solution.
- H^+ ions are also liberated producing acidic solution.
- This acidic solution formed, is termed Acid Mine Drainage.
- Acid generation and drainage affect both surface and groundwater.
- High concentrations of metals and acidic conditions have adverse effects on aquatic life and humans.

WHY MINE CLOSURE IS REQUIRED

MINING CAUSES EROSION AND SEDIMENTATION:

- **Erosion and sedimentation affect surface water and wetlands.**
- **It results in movement of soil, including topsoil and nutrients, from one location to another.**
- **Erosion adversely affect soil organisms, vegetation, and revegetation efforts.**

WHY MINE CLOSURE IS REQUIRED

MINING MAY CAUSE CYANIDE & OTHER CHEMICAL RELEASES:

- **Cyanide and other toxic chemicals such as oil, petroleum products, solvents, acids, and reagents used for processing are released into the environment.**
- **They affect water, soil, aquatic organisms, wildlife, waterfowl, and humans.**

WHY MINE CLOSURE IS REQUIRED

MINING CAUSES LAND DEGRADATION, SUBSIDENCE OF LAND AND MINE FIRES:

- **Land is broken, fragmented and losses its nutrient value.**
- **Subsidence of land causes instability of structures above ground.**
- **Occurrence of mine fires in coal mines due to spontaneous combustion.**

WHY MINE CLOSURE IS REQUIRED

MINING CAN CONTAMINATE SURFACE & GROUNDWATER:

- **Water becomes easily contaminated at mine sites when it comes into contact with waste rock and tailings.**
- **Surface water and groundwater can run off site contaminating downstream water bodies with highly acidic, metal laden wastewater.**
- **Massive quantities of water use for processing minerals etc. can cause drawdown of the groundwater table.**

WHY MINE CLOSURE IS REQUIRED

MINING PRODUCES FUGITIVE DUST & EMISSIONS:

- **Dust originates from ore crushing, transportation, blasting, from haul roads, waste rock piles, tailings, etc.**
- **Dust can contain toxic heavy metals like arsenic, lead, and etc.**
- **These toxic heavy metals contaminate the air.**
- **Dust also deposits in surface water causing sedimentation and turbidity problems.**

WHY MINE CLOSURE IS REQUIRED

MINING CAUSES HABITAT MODIFICATION:

- Mining can adversely affect aquatic habitats (i.e. lakes, ponds, streams, rivers), terrestrial habitats (i.e. deserts, grasslands, forests), and wetlands that many organisms rely on for survival.

- The disruption of site hydrology by large consumption or release of water, manipulation of topography, and the release of particulates and chemicals can all have indirect impacts on various habitats.

SOLUTION :
A MEANINGFUL MINE CLOSURE

VISION OF A MINE CLOSURE PLAN should be to ensure that a process is established to guide all decisions & actions during a mine's life such that:

- **Environmental resources are not subject to physical and chemical deterioration.**
- **Future public health and safety are not compromised.**
- **Post-mining use of the site is beneficial and sustainable in the long term.**
- **Adverse socio-economic impacts are minimized, Opportunity is taken to maximise socio-economic benefits.**

OBJECTIVES & PRINCIPLES OF MINE CLOSURE

1. STAKEHOLDER INVOLVEMENT:

TO ENABLE ALL STAKEHOLDERS TO HAVE THEIR INTERESTS CONSIDERED DURING THE MINE CLOSURE PROCESS.

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

OBJECTIVES & PRINCIPLES OF MINE CLOSURE

2. PLANNING:

TO ENSURE THE PROCESS OF CLOSURE OCCURS IN AN ORDERLY, COST-EFFECTIVE AND TIMELY MANNER.

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

OBJECTIVES & PRINCIPLES OF MINE CLOSURE

3. FINANCIAL PROVISION:

TO ENSURE THE COST OF CLOSURE IS ADEQUATELY REPRESENTED IN COMPANY ACCOUNTS AND THAT THE COMMUNITY IS NOT LEFT WITH A LIABILITY.

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

OBJECTIVES & PRINCIPLES OF MINE CLOSURE

4. IMPLEMENTATION:

TO ENSURE THERE IS CLEAR ACCOUNTABILITY, AND ADEQUATE RESOURCES, FOR THE IMPLEMENTATION OF THE CLOSURE PLAN.

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

OBJECTIVES & PRINCIPLES OF MINE CLOSURE

5. STANDARDS:

TO ESTABLISH A SET OF INDICATORS WHICH WILL DEMONSTRATE THE SUCCESSFUL COMPLETION OF THE CLOSURE PROCESS.

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

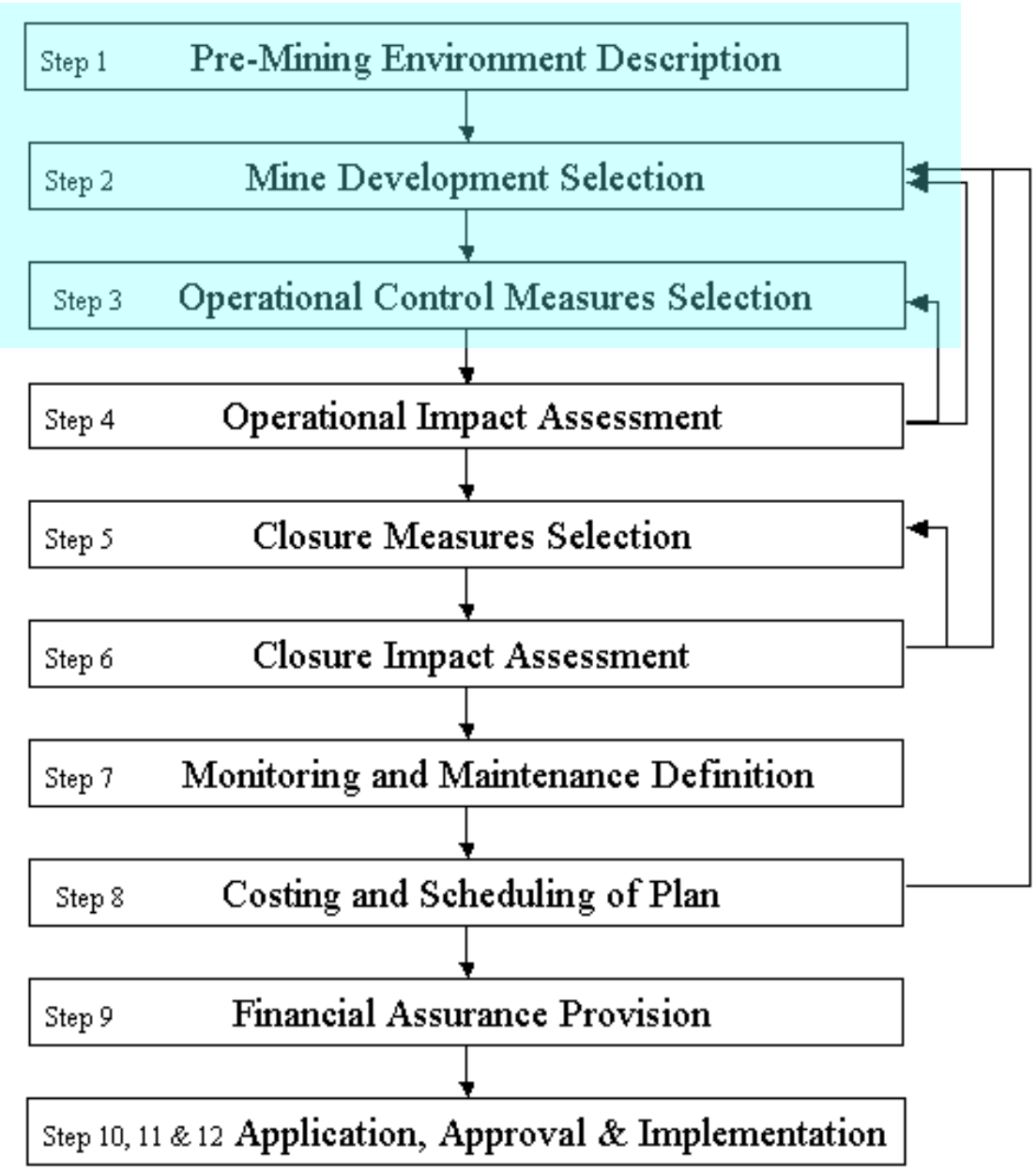
OBJECTIVES & PRINCIPLES OF MINE CLOSURE

6. RELINQUISHMENT:

TO REACH A POINT WHERE THE COMPANY HAS MET AGREED COMPLETION CRITERIA TO THE SATISFACTION OF THE RESPONSIBLE AUTHORITY. RESPONSIBLE AUTHORITY SHOULD BE IDENTIFIED AND HELD ACCOUNTABLE TO MAKE THE FINAL DECISION ON ACCEPTING CLOSURE.

- **Once the completion criteria have been met, the company may relinquish their interest.**
- **Records of the history of a closed site should be preserved to facilitate future land use planning.**

STEPS IN CLOSURE PLAN DEVELOPMENT

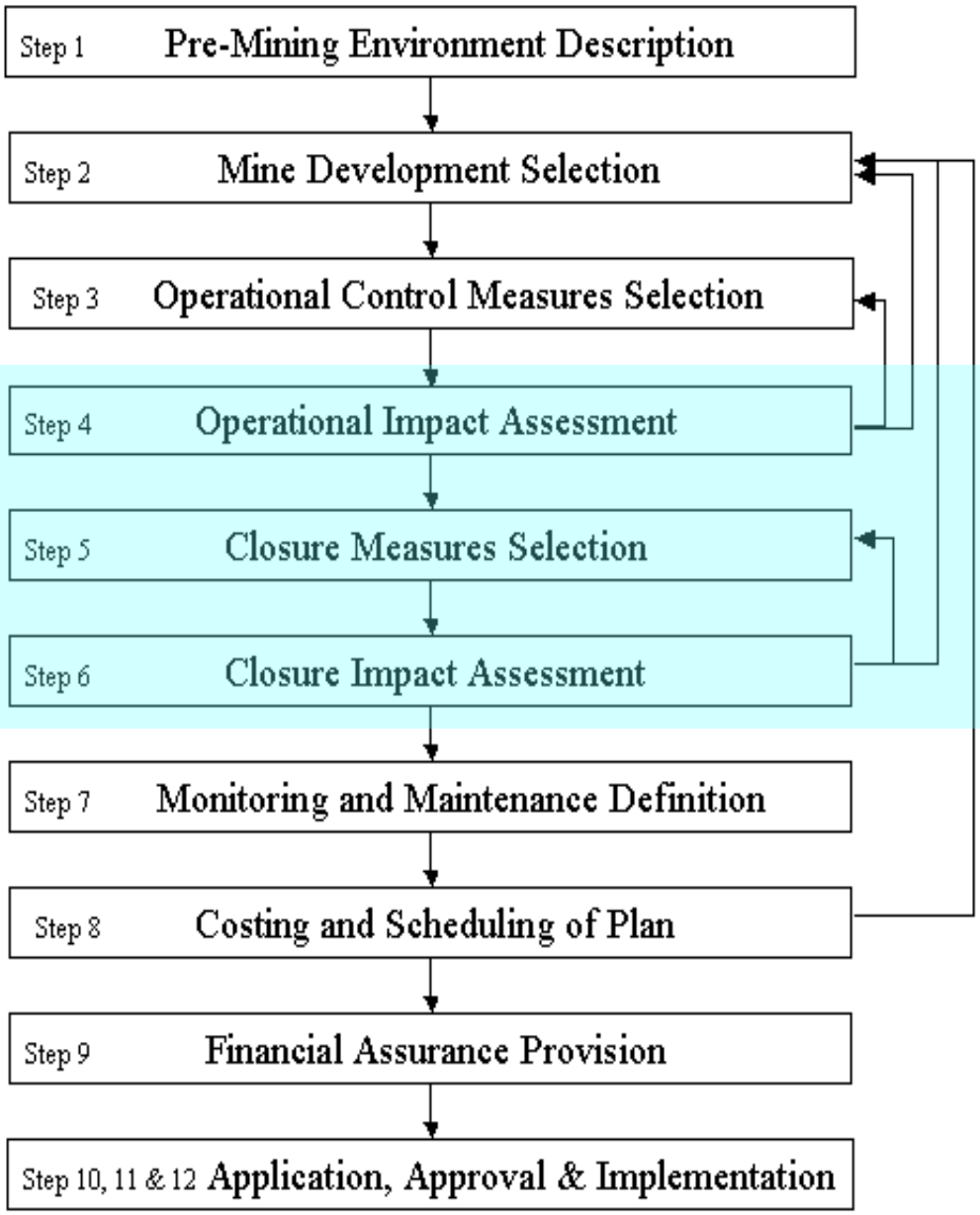


A closure plan must consider the long-term physical, chemical, biological and social/land-use effects on the surrounding natural systems (aquatic, groundwater, surface water etc.).

Therefore there must be an understanding of the pre-mining environment (STEP 1) and the effects of past and future mine development (STEP 2) on the pre-mining environment.

Operational control measures must be selected (STEP 3) to minimize the impact on the surrounding ecosystems.

STEPS IN CLOSURE PLAN DEVELOPMENT

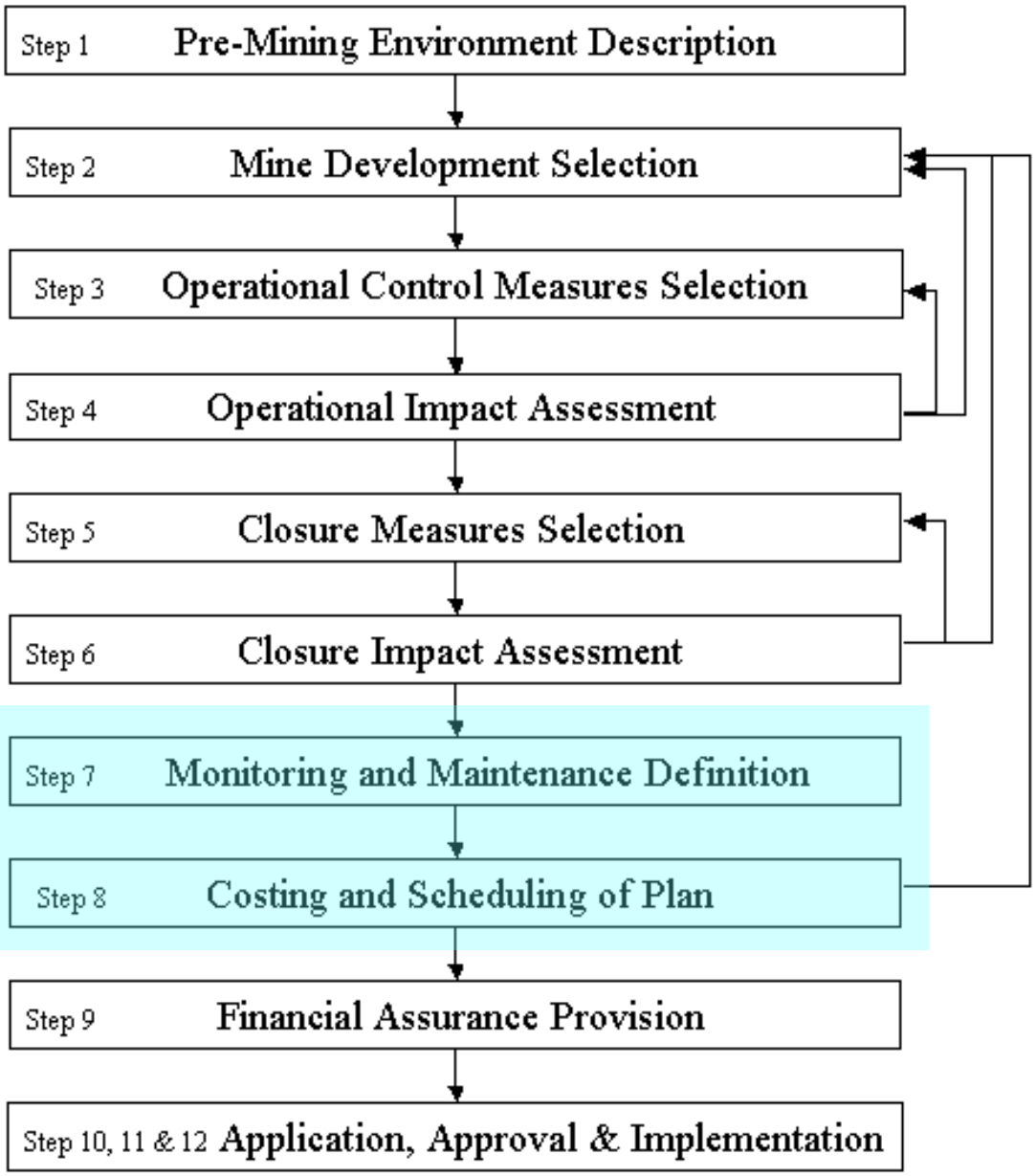


Impact assessments (STEP 4) must be done prior to measures selection as well as periodically during operations in order to determine the success of the measures implemented.

Alternative mine closure measures are developed (STEP 5) & assessed (STEP 6) during mine design to ensure that there are suitable closure measures available to remediate the impact of the selected mine developmnt.

If suitable remediation or closure measures cannot be identified or achieved, then it may be appropriate to revise the type of mine development proposed (return to STEP 2).

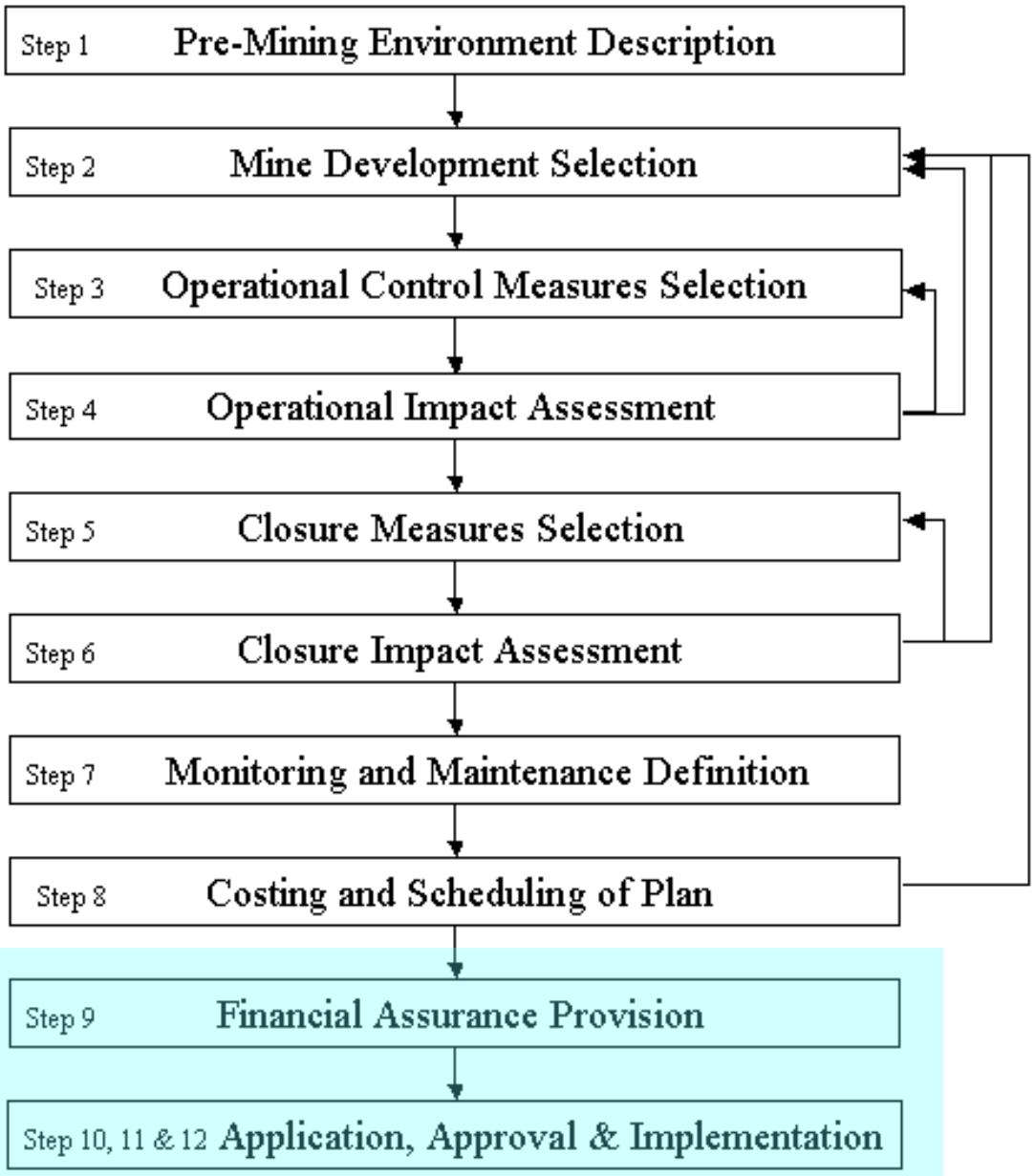
STEPS IN CLOSURE PLAN DEVELOPMENT



Once a technically acceptable mine development and closure plan has been developed it is necessary to prepare a monitoring and maintenance plan (STEP 7) that will monitor the system performance during operations and post closure to ensure the long term functionality of the system.

Throughout this process, costing and scheduling evaluations (STEP 8) are completed, if the costs are too onerous, the process returns to the design phase (STEP 2) and alternative measures are evaluated

STEPS IN CLOSURE PLAN DEVELOPMENT

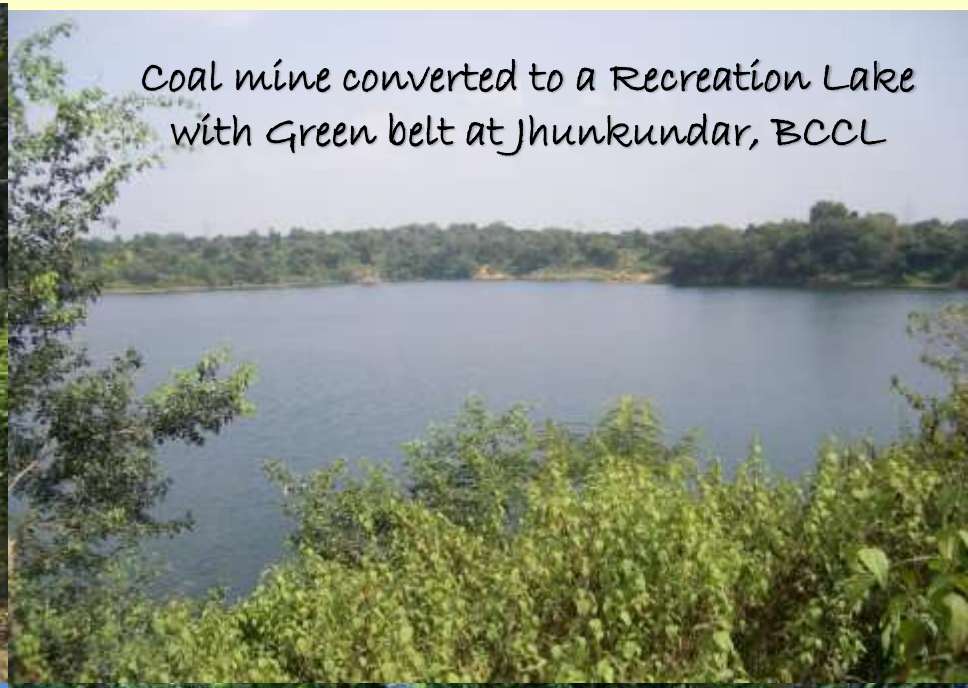


Once an acceptable plan is completed, an acceptable form of financial assurance is developed and provided (STEP 9) in order to cover the costs of plan implementation, long term operations, monitoring and maintenance of the site post closure.

The final stages of the closure plan involve the application for (STEP 10) and approval by (STEP 11) the regulatory agencies of the Closure Plan, and implementation (STEP 12).

Best Practices of Mine Closure

Coal mine converted to a Recreation Park, WCL



Coal mine converted to a Recreation Lake with Green belt at Jhunkundar, BCCL

Lignite mine converted to a Park with Cafetaria at Neyveli, NLC

Lignite mine converted to a Wet land habitat at Neyveli, NLC

Reclamation & Restoration as Mine Closure at Jharia mines

Lodna mine before restoration, 2014

After Ecological Restoration, Gokul Park, 2019

Socio-Eco-Cultural Park (Gokul Park) at Lodna mined out area in Jharia Coal mining area with an aim to provide a place for recreation activities. The site is well accepted by the local people as picnic as well as religious spot.

Horticultural initiatives on Mined out areas at Jharia mines


Paddy grown at Gondhudih mine


Crop at Lodna mine


Mustard and Wheat cultivation at Lodna mine


Sugarcane grown at Gondhudih mine


Flowers grown at Muraidih mine


Wheat grown at Kusunda mine


Vegetable crops being grown at the Muraidih mine


Maize cultivation at Katras mine

Creation of Parks on reclaimed land

MINE CLOSURE GUIDELINES
BY
INDIAN BUREAU OF MINES
(IBM)

PREAMBLE (IBM)

1. All the mining lessees are required to submit the PROGRESSIVE MINE CLOSURE PLAN as per the Mineral Concession Rules & Mineral Conservation and Development Rules. Progressive mine closure plan will be an additional chapter in the present mining plan and will be reviewed every five years in the Scheme of Mining.

2. Mine closure encompasses rehabilitation process as an ongoing programme designed to restore physical, chemical and biological quality disturbed by the mining to a level acceptable to all.

3. FINAL MINE CLOSURE PLAN shall have its approval at least nine months before the date of proposed closure of mine.

CLOSURE PLAN SHALL CONSIST OF

- ***Mined-Out Land***
- ***Water Quality Management***
- ***Air Quality Management***
- ***Waste Management***
- ***Top Soil Management***
- ***Tailing Dam Management***
- ***Infrastructure***
- ***Disposal of Mining Machinery***
- ***Safety and Security***
- ***Disaster Management and Risk Assessment***
- ***Care and maintenance during temporary discontinuance***

CLOSURE PLAN SHALL CONSIST OF

Abandonment Cost : **Cost to be estimated based on the activities required for implementing the protective and rehabilitation measures including their maintenance and monitoring programme, along with Time lines.**

Certificate : **That all mentioned actions have been taken to be stated clearly in the mine closure plan. A certificate duly signed by the lessee that said closure plan complies all statutory rules, regulations, orders made by the Central or State Government, statutory organisations, court etc. have been taken into consideration. The lessee should also give an undertaking to the effect that all the measures proposed in thes closure plan will be implemented in a time bound manner as proposed.**

Plans, Sections etc. : **The Closure Plan to be submitted depicting photographs, satellite images on compact disc etc. wherever possible.**

GUIDELINES FOR PREPARATION OF MINE CLOSURE PLAN FOR COAL MINING OPERATIONS (BY MINISTRY OF COAL dated 27-8-2009)

GUIDELINES FOR PREPARATION OF MINE CLOSURE PLAN (MOC)

- ✓ **Mine Closure Plan shall be incorporated in the Project Report for a new mine. The Mine Closure Plan (progressive and final) shall be approved along with the approval of Mining Plan/ Feasibility Report/ Project Report as applicable.**

- ✓ **The Mine Closure Plan will have two components viz. i) Progressive or Concurrent Mine Closure Plan and ii) Final Mine Closure Plan. Progressive Mine Closure Plan would include various land use activities to be done continuously and sequentially during the entire period of the mining operations, whereas the Final Mine Closure activities would start towards the end of mine life, and may continue even after the reserves are exhausted and/or mining is discontinued till the mining area is restored to an acceptable level.**

GUIDELINES FOR PREPARATION OF MINE CLOSURE PLAN (MOC)

- ✓ **Total cost estimate to be assessed based on the activities as mentioned. Money to be levied per hectare of mining lease is to be deposited every year after commencement of any activity on the land for the mine after opening on Escrow Account.**

- ✓ **Details of the Final Mine Closure Plan along with cost estimates for various mine closure activities and the Escrow Account already set up shall be submitted to the Ministry of Coal for approval at least five years before the final closure of the mine.**

- ✓ **Statutory obligations: The legal obligations if any which the lessee is bound to implement like special conditions imposed while execution of lease deed, approval of mining plan, conditions imposed by the Ministry of Environment and Forests, State of Central Pollution Control Board or by any other organization describing the nature of conditions and compliance position thereof should be indicated here.**

- ✓ **After the closure of the mine, the reclaimed leasehold area and any structure thereon, which is not to be utilized by the mine owner, shall be surrendered to the State Govt.**

FINAL MINE CLOSURE PLAN SHALL CONSISIT OF

- ✓Mined-Out Land
- ✓Water Quality Management
- ✓Air Quality Management
- ✓Waste Management
- ✓Top Soil Management
- ✓Management of Coal Rejects from Washery
- ✓Infrastructure
- ✓Disposal of Mining Machinery
- ✓Safety and Security
- ✓Economic Repercussions of closure of mine: Manpower retrenchment, compensation to be given, socio-economic repercussions and remedial measures consequent to the closure of mines should be described, specially the envisaged expectation of the society on closure of mine.

GUIDE LINES FOR PREPARATION OF FINAL MINE CLOSURE PLAN (MOC)

Time Scheduling for abandonment: The details of time schedule of all abandonment operations should be described and should also be supplemented by bar charts etc.

Abandonment Cost: is to be estimated at the time of preparation of Project Report/Mining Plan. Supervision charges for 3 years, power cost, protective and rehabilitation measures including their maintenance and monitoring, miscellaneous charges etc.

It has been estimated that typically closure cost for an opencast mine will come around Rs. 6.0 Lakhs per hectare of leasehold and would be Rs. 1.0 Lakhs per hectare for underground mine leasehold at current price levels (August, 2009) and these rates will stand modified as notified by Government of India from time to time.

Annual closure cost is to be computed considering the total leasehold area at the above mentioned rates and dividing the same by the life of the mine or 25 years which ever is lower. An amount equal to the annual cost is to be deposited each year throughout the mine life compounded @5% annually. For example if the annual cost works out to Rs 100, then in the first year the amount to be deposited will be Rs 100, in the second year 100x(1+5%)^1, in the third year 100x(1+5%)^2 and so on.

GUIDE LINES FOR PREPARATION OF FINAL MINE CLOSURE PLAN (MOC)

Financial Assurance:

- **For financial assurance the mining company shall open a Escrow Account with any Scheduled Bonk, with the Coal Controller Organization.**
- **When implementation of the final mine closure scheme is undertaken by the mine owner starting five years before the scheduled closure of mining operations, the Coal Controller may permit withdrawals (four years before final mine closure date] from the Escrow Account proportionate to the quantum of work carried out, as reimbursement. The withdrawn amount each year shall not exceed 20% of the total amount deposited in the account.**
- **An agreement, outlining detailed terms and conditions of operating the Escrow account, shall be executed amongst the mining company, the Coal Controller and the concerned bank.**

Responsibility of the Mine owners: It is the responsibility of the Mine owners to ensure that the protective measures contained in the mine closure plan including reclamation and rehabilitation works have been carried out in accordance with the approved final mine closure plan.

Provision for Mine Closure: The mine owner shall be required to obtain a mine closure certificate from Coal Controller to the effect that the protective, reclamation and rehabilitation works in accordance with the approved mine closure plan/final mine closure plan have been carried out by the mine owner for surrendering the reclaimed land to the State Government concerned.


THANK YOU