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Environmental Impact Evaluation of Mining

Amosu Cyril Olumuyiwa

Department of Mineral and Petroleum Engineering, Yaba College of Technology, Yaba, Nigeria

ABSTRACT

It was taken into account before irrevocable development decisions are made. This paper attempts to review the developed framework for use into mining project proponents in the preparation of Environmental Impact Evaluation reports to meet the requirements of the Mines, Minerals Act and other statutory and legislative instruments dealing with the environment. It describe the significance of the environmental impact assessment(EIA) and its report or guidelines, as well as the procedures in stages on how project proponent interfaces with the federal ministry of environment and other entities in project management. It considers the environmental management plan (EMP) as compensatory measures for EIA and Mentioned also was the ability to identify key environmental impacts against project cycle for mining. The criteria and categories of mining projects according to environmental impact levels were discussed.

KEYWORDS: *Mining, Environment, Impact, Assessment, Evaluation, Project, Level, Public, Report, Proponent*

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INTRODUCTION

Mining is widely regarded as having adverse effects on environment of both magnitude and diversity which include erosion, formation of sinkhole, biodiversity loss and contamination of groundwater by chemical (Monjezi et al, 2009). Although mining activities affect relatively small areas but can have a large local impact on the environment (Salomons, 1995).

EIA:

Environmental Impact Evaluation (EIA) is an official process by which a proposed event with inherent environmental magnitude, social and economic costs is critically observed with a view to assessing its effects, examining optional approaches and developing ways to avoid or correct the negative effects of a project and work on the positive ones (Allan and Chilenye, 2014).

EIA REPORT:

It is a document that realises the following overall aims:-

A. To meet the environmental needs and directives under the Mines and Minerals

B. Act No. 17 of 1999 and other statutory and legislative instruments.

C. To provide a sole document that will meet the need of the various authorities that are concerned with the regulation of the environmental impacts of mining.

D. To give reasons for the requirement for, and the overall gain of, the proposed project.

E. To describe the right baseline environmental conditions at and around the proposed site.

F. To describe shortly the mining method and related activities so that an evaluation can be made of the significant effects that the project is possibly to have on the environment during and after mining.

G. To describe how the negative environmental effects will be managed and how the positive impacts will be optimized.

H. To set out criteria for the environmental management that will be used during the life of the project so that the stated and agreed land capability and aims of closure can be realized and a closure certificate issued.

I. To indicate that resources will be provided to implement the programme of Environmental management that set out in Part 6 of the EMP (Guidelines for Preparing EIA Reports, 2003).

EIAs have surfaced as a result of the environmental problems of mining, economic and energy developments. Increasing emphasis has been placed in recent years on development of the theory of Environmental Impact Assessment, primarily as a consequence of increasing recognition that the theoretical basis of 'state-of-the-art' EIA is inadequately developed and detailed (Matthew, 2004). One of the basic purposes for conducting (EIAs) is to create public awareness of the proposed projects and to engage them in meaningful talks about the inherent gains and environmental and social costs of proposed operational events. Although, inviting public participation too early may create barriers (Hartley and Wood 2005), but a serious cultural change in them (public institutions, project owners,

and the citizens) is required in terms of understanding the real importance of public participation, and therefore to provide a framework for effectively practicing this right (Lostarnauetal et al, 2011).

Environmental impact assessment is an intrinsically complex multi-dimensional process, involving multiple criteria and multiple actors (Ramanathan, 2001). Public participation in EIA is commonly deemed to foster democratic policy-making and to render EIA more effective (Anne et al, 2013).

Its relevance is identification and mobilization of safeguards to correct harsh environmental effects from the proposed events. EIA systems have been developing globally starting with the US National Environmental Policy Act of 1969, which needed EIAs for nationally funded or supported projects in the USA that had inherent environmental impacts. In 1970s, countries like France, Australia, West Germany, New Zealand and Canada adopted the systems of EIA. Bangladesh enacted EIA legislation in 1995 and EIA rules in 1997, and today all major donor agencies working in Bangladesh have their own EIA guidelines (Salim, 2002). The rise of the use of EIAs automatically leads to improved practice and promotes sustainable development (Sadler et al, 2011).

The EIA procedure is made up of seven stages:
(1) Project proposal, (2) Screening, (3) Scoping, (4) Draft EIA Report and Review Process, (5) Final EIA Report, (6) Decision-Making, and (7) Project Implementation.

Project Proposal: This is the first stage where the proponent of the project submits a work proposal to the Federal Ministry of Environment. The proposal shall include a map of land use and all vital information concerning the project, whereupon the Ministry shall issue the proponent guidelines that will facilitate the EIA process (Femi, 1998).

Screening : This is the second stage also called the screening stage which involves an examination of the work by the Ministry for the purpose of determining whether the project is the one in which an EIA is compulsorily needed or not; or the one in which it may not be carried out. Given the nature of oil and gas exploration and production, as well as mining development, it is not possibly that the exemption will be applied to oil, gas and mining projects because their development normally have more than minimal environmental impacts and may automatically make up for emergency in the interest of public health and safety to explore for and produce mineral oil. The Ministry is needed to complete this process within three weeks of receiving payment for the proposed work.

Scoping: The work proponent is needed to map out the scope of the intended EIA as soon as the Ministry determines that an EIA is needed, or may be needed (and decides that it should be carried out). This involves an identification of the inherent effects of the work, qualifying those effects as useful or as harsh (Akintunde and Akin, 2011).The work proponent submits the result of the scoping tasks to the degree of public interest in the project; the Ministry may require the work proponent to undertake additional studies of the work and may arrange a public hearing. Accordance with a term of reference agreed to with the Ministry, the work proponent shall then conduct an EIA.

Draft EIA Report and Review Process: The fourth stage comprises of the work of the proponent's submission of an EIA report draft to the Ministry and the review of the report of the Ministry. The Ministry shall inform the work proponent of the selected review method. The review process may involve site visits, public hearing, or mediation. The Ministry shall, within 60 days of receipt of the work proponent's submissions, communicate its comments to the work proponent, which may require amendments to the project.

Final EIA Report: The fifth stage is the submission of the final EIA report by the Work proponent. The report is to be submitted within twenty-four weeks of the receipt of the work proponent's of the comments of the Ministry concerning the previous draft. According to Section 4 of the EIA Act, it is needed that the report includes the following at least:

A. an evaluation of the possible or inherent environmental effects on the proposed operational events and the options, including the direct or indirect overall, short-term and long-term impacts;

B. the proposed events and evaluation of those measures;

C. an indication of gaps in knowledge and uncertainly which may be encountered in preparing the needed information;

D. a description of the proposed events;

E. a description of the inherently affected surrounding including specific information needed to identify and evaluate the surrounding impacts of the proposed works;

F. a description of the practical operational events, as appropriate;

G. A concise and non-technical summary of the information made available under paragraphs (a) to (g) of this section.

Decision-Making: The sixth stage is the approval stage of the final EIA report. A technical committee of the Ministry is the approving authority. At this stage, the EIA Act expressly needs the participation of the public. The Ministry of Environment make decisions on an operational event to which an environmental evaluation has been prepared, the Agency shall give government agencies, members of the public, experts in any needed discipline and interested groups the privilege to make comments on the environmental effects and evaluation of the operational event. The approval process comprises of the publication of a notice of the Ministry which will state:

A. the date on which the mandatory study report shall be provided to the public;

B. the venue at which copies of the report may be acquired; and

C. the deadline and place for filing comments on the conclusions and recommendations of the report.

The panel for review is needed to hold hearings in a way that gives the public a privilege to partake in the EIA. The following factors shall be considered in the review:

A. the environmental impacts of the project, taking into account its overall effects with other projects that have been or will be carried out;

B. the magnitude of those impacts;

C. comments gotten from the public concerning those impacts;

D. correctional measures that are technically and economically feasible;

E. the requirements of any program of follow-up relating to the project;

F. The inherent ability for regeneration of renewable resources that are possibly going to be seriously affected by the project.

Project: The final stage in the EIA procedure is the implementation stage. Here, the Ministry certifies the EIA after reviewing the process and the work proponent implements the project in relation with the EIA report. Furthermore, the Ministry is needed to monitor the progress of the project to ensure that the work proponent complies with the established conditions, including measures needed to correct the harsh effects from the project (Allan and Chilenye, 2014).

TIME TO CONSIDER EIA INPUTS

The review panel assigned by the Federal Ministry of Environment requires the public input to EIAs at the stage of review of the EIA reports . It has been debated that public inputs should be needed as early as possible – beginning from the time of the impact evaluation by the work proponent. The late involvement of the public might result in the governmental authority seeking to justify results already concluded (Oronto, 1999).

ENVIRONMENTAL MANAGEMENT PLAN (EMP) AND POST-EVALUATION MONITORING

The fruition of an EIA system does not terminate with the generation of the EIA report, no matter the effectiveness of the EIA process. The preparation of an Environmental Management Plan is important. An EMP is a concise plan and schedule of the measures that are vital to tackle the inherent effects noted through the EIA. Those measures are to be undertaken during the implementation of the project to either terminate or reduce the adverse effects of the project. An EMP includes the specific actions needed to implement the measures. It should spell out the costs relating to the implementation of the measures, the compensatory measures available should in case the measures fail to holistically address the adverse impacts of the project, and the institutional arrangements provided to implement the measures, i.e., the officers, bodies or agencies put in place to implementing the measures (Pacifica, 2007). Connected with an EMP is post-monitoring of the EIA implementation process. An effective EIA process continues up to the time the project is completed. After the approval of an EIA, it is necessary to monitor whether the proposed correctional measures are being implemented and, if they are, how they are functioning. The implementation of a project lay-out may show gaps in the EIA that were not initially noticed but which require to be addressed. Environmental intelligence thus makes available continuous feedback for strategies and operational variables and institutions (Dabholker, 1991). The effectiveness of an EIA relies on the 'degree of success in synergizing evaluation and findings into making decisions in the planning and work cycle' and that this has low occurrence in developing nations which culminates into poor connections with implementation of project (Allan and Chilenye, 2014). Industrial decision-making like locations, management practices are affected by EIA requirements, documents and methodology (David, 2004).

MULTIPLICITY OF REGULATORS

To ensure that an effective EIA process is positioned, a transparent regulatory authority is important. Conflicts are created by the presence of multiple authorities which confuses project operators who are willing to stick to best EIA practices, and makes it easy for dishonest operators to shirk what their responsibilities is (Allan and Chilenye, 2014).

NEW PROJECTS

It is imperative to address the inherent environmental impact issues that may crop-up due to proposed mining projects i.e. an evaluation of the inherent impacts of a project on the pre-mining locations. The plans needed for the EIA must be at appropriate scales to reveal the level of details needed for the specific project or described aspect, i.e.

1. 1:50,000 scale plans is suitable for regional and catchment descriptions;
2. 1:10,000 scale plans is suitable for surface mining layouts, pre-mining environmental conditions, infrastructure layouts, the plans for the environmental management programme, water and waste management facilities;
3. 1:2,000 or even 1:1,000 are needed to show the details of river diversion and water reticulation aspects such as return water dams, pollution control dams, seepage collection and clean water diversion works and evaporation facilities.

OPERATING MINES

For operating mines the emphasis changes from an evaluation of the inherent impacts of a project on the pre-mining environment to that of setting up the actual impacts of an operating mine on an environment in which development has already occured.

CORPORATE OR EXECUTIVE SUMMARY OF THE EIA

The corporate or executive summary should summarise the overall advantages of the project, emphasize the main environmental research and how these will be managed to by-pass, reduce or re-amend the adverse impacts. The overall closure and post-mining land a aims should be stated glaringly (Guidelines for Preparing EIA Reports, 2003).

PROJECT CYCLE FOR MINING

This is the cycle of any typical mining project and it identifies key environmental impacts in each phase and these are:

A. EXPLORATION PHASE:

A mining project commences with knowledge of the worth and extent of the ore deposit of the outlying mineral. Information about the site and worth of the ore deposit of the mineral is gotten during the exploration phase. This phase includes field studies, surveys, exploratory excavations and drilling test boreholes. For mining which involves large size, the exploratory phase may involve clearing of large areas of vegetation, to allow the entry of large vehicles that has drilling rigs mounted on them, or even excavation in open pit mining, manually. Projects in this phase should be subjected to EIA depending on the area covered because of the extensive opening up of earth that is involved. A different EIA is needed for the exploratory phase

because the license provided for exploration is not the same for that of exploitation, because their environmental impacts from are also not the same (Guidelines for EIA, 2012).

The main steps in Exploration are summarized as follows:

1. **Preliminary evaluation of mining area and identification of areas with good prospects**, usually a large area likely known to be mineral bearing (ancient mines, historical records and so on), use of aerial photography, geological maps, remote sensing and so on.
2. **Preliminary ground exploration** i.e. drilling programmes to identify smaller scale targets as most important for exploration effort like geochemical sampling, geophysics.
3. **Initial drilling programmes**: Is widely spacing out points of information seeking a mineralisation discovery.
4. **Infill drilling more closely spaced drilling and sampling:** Is carried out to confirm geology/grade continuity.
5. **Detailed exploration designed to optimise the mine design**: This points to reduce uncertainty using initial number of mining years, like pit slopes, water modelling, stope design and so on.

B. CONSTRUCTION OR PREPARATION PHASE:

This is the development of the entire mine and its facilities, the processing (mill) plant and other related infrastructure (staff houses, offices, water supply facilities), in preparation for the operation. This phase has several distinct sub-components like clearing and site preparation and construction of network of roads, rails and airstrips. (Guidelines for EIA, 2012).

C. EXPLOITATION OR ACTIVE MINING PHASE:

The Environmental impacts in this phase depend greatly on the mining methods used like:

1. **Open-pit or Strip mining:** This is the most common type of mining in which the ore deposit extends very deep into the sub-surface depth and involves the clearing of overburden, trees and vegetation, and ore layer by layer using heavy machinery like bulldozers and dump trucks. It normally causes pit formations that extend below the groundwater table which must be pumped out to allow mining to take place.
2. **Placer mining or hydraulic mining:** Placer mining is used when the ore aimed at is related with sand sediments in a floodplain or stream bed using bulldozers, dredges, or hydraulic jets of water to extract the ore. Placer mining is usually aimed at removing gold from stream sediments and floodplains. it is destructive environmentally since it releases large quantities of sand sediments that can effect surface waters going downstream.
3. **Underground mining** It is used to gain access to ore deposit through tunnels or shafts**.** It is more environmentally friendly that a minimal amount of overburden is removed to gain access to the ore deposit, although it is often more costly and entails greater safety risks than strip mining.
4. **Reworking inactive or abandoned mines and tailings**: It involves reworking of waste piles (often tailings) from inactive or abandoned mines, or older waste piles at active mines done on-site or offsite using processing facilities. It impacts on the environmental during beneficiation or purification of metals from the waste piles.
5. **Disposal of overburden and waste rock:** This involves moving or excavating mineral ores that are buried under a layer of overburden or waste rocks (which are enormous and high-volume) in order access to the ore deposit. A proposed mining project could produce more than billions of metric tons of overburden and waste rocks which sometimes contain toxic substances found on-site, in piles on the surface or as backfill in open pits, or inside underground mines.
6. **Ore extraction:** It involves the extraction of the mineral ore transported to processing facilities using specialized heavy machineries and equipment such as dump trucks, haulers, loaders. It forms a distinct batch of environmental impacts, such as fugitive dust emissions from haul roads which an EIA for a proposed mining project should assess separately.

D. DECOMMISSIONING OR CLOSURE AND REHABILITATION:

Mine closure and post-closure rehabilitation should be projected and planned for before the termination of mining operations which should be at least 3-5 years. The aim of the last plan of closure is to ensure that the mine location is abandoned in a good working profile with respect to the ecosystem using the reference as the pre-mining background. The underlying aim is to make it available and prepared for future uses of land. This activities typically includes:

A. Bringing down buildings and physical infrastructure;

B. Filling open pits;

C. Restricting the public to have access to underground shafts and workings;

D. Reclamation of mining the bench and slopes;

E. Ascertain human health and the environment against risks by ensuring that water draining from the mine site and waste deposits are treated.

The project phases and some related environmental impacts are summarised in figure 1:

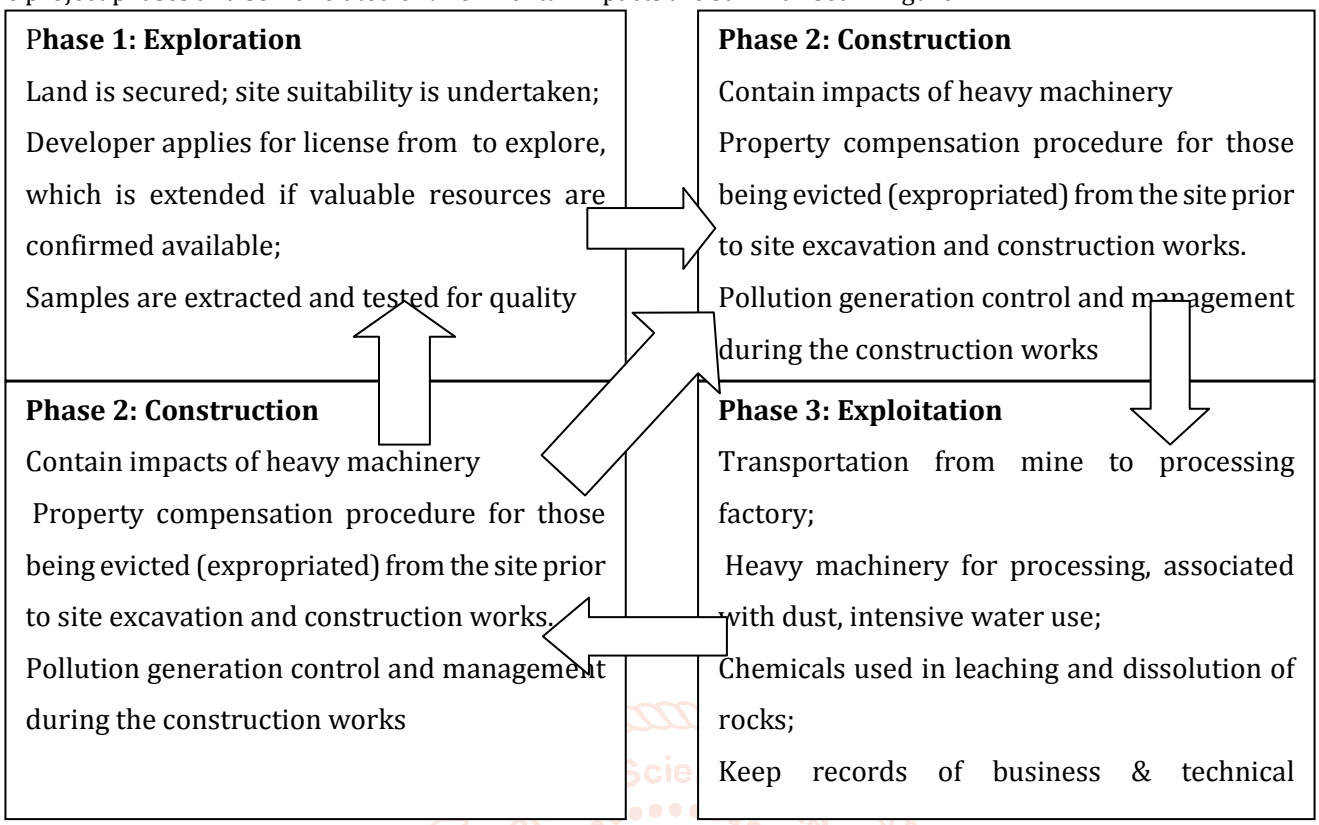

Figure 1: Phases of a Mining Project and related environmental (Guidelines for EIA, 2012).

CRITERIA FOR THE CLASSIFICATION OF MINING PROJECTS

Mining and mineral processing projects have differing effects on the environment depending on some factors. Impact assessment practice around the world is dominated by its use at the project level, with particular emphasis on major projects (Wood, 2003). The following criteria are used to classify mining projects according to the inherent impact levels:

Stage of Project: Most times, research and prospecting activities are related with lower environmental impacts compared to mineral extraction, construction and operational activities.

Size of Mining Area: Licenses covering areas as large as 1000 Ha or more are definitely categorised as IL 3, even if they are at prospecting stage, while those covering less than 10 Ha that has alteration due to land and water displacement has higher environmental impacts.

Project Location: Projects sited as follows invariably are categorised in IL 3 (high impact areas):

A. Ecological activities covering the forests, wildlife habitats, wetlands, steep slopes.
B. Legally activities involving national or international law and concern trans-boundary ecosystems, international riverbanks and lake shores, national parks, archaeological sites.
C. Socio-culturally activities bordering on dense population, national monuments, memorial sites, burial grounds/cemeteries),

Number of people employed: Projects that employ people beyond one hundred for an extended period of time are categorised as high impact and therefore fall in IL 3.

Nature of the ore being extracted: Some Minerals like gold, Copper is associated with high use of chemicals and tin ores which is Cassiterite goes through leaching.

Project design and layout: This is the level to which mineral ores and its raw materials are transported, stored, sold, and disposed of, over a long distance.

CATEGORIES OF MINING PROJECTS ACCORDING TO ENVIRONMENTAL IMPACT LEVELS

For the aim of making tactical decisions which dictate the level of EIA such a project is subjected to. These levels are 3 classes based on a set of criteria for classification of Mining Projects i.e.: IL 1, IL 2, and IL 3 (Guidelines for EIA, 2012).Mining projects are classified into 3 categories as follows:

IMPACT LEVEL 1 (IL 1):

Projects do require unlimited environmental analysis. Projects in this category are considered to have a low risk of serious environmental impacts. Correctional measures can be integrated in the project design without necessarily requiring a detailed EIA. Mining projects in this category have minimal harsh impacts. They are classified as small mining projects and include small scale (artisanal) mining activities in less ecologically sensitive areas limited to exploitation and mining activities of sand, clay, stones, gravel. (Guidelines for EIA, 2012).

Mining projects will be categorised under impact level 1 (IL 1) if the screening process determines that the proposed project satisfy the following conditions:

A. Inherent residual impacts on the environment are likely to be insignificant, minor and easily corrected.
B. Reliable ways exist to make sure that impact management measures are adequately planned and implemented.
C. The project will not displace high numbers of people, families or communities.
D. The project is not sited in, and will not affect:
E. Locations that are environmentally-sensitive such as: National parks, Wetlands, Important archaeological, historical and cultural places, habitats of rare or endangered flora or fauna species and natural forests.
F. Locations protected under legislation.
G. Areas containing distinct or stand-alone scenery.
H. Developments or Mountains near or on steep hill slopes, Lakes and rivers.
I. Locations important for vulnerable groups of citizens such as the fishing communities;
J. Locations near high population concentrations or industrial activities where further development could create noticeable cumulative environmental challenges.
K. Locations of ground drainage basins or water recharges.
L. The project will not cause:
M. Policy initiatives which may disturb the environment
N. Major alterations in land tenure
O. Alteration in water use through dams, drainage promotion, irrigation or fishing.

IMPACT LEVEL 1 (IL 2): The mining projects in this category are classified as medium sized risks. Projects do not require a full EIA but necessitate further level of evaluation and its EIA process is similar to that of IL3 projects. It has adverse but reversible environmental impacts and correctional and management measures that are readily designed and factored into the project. (Guidelines for EIA, 2012).

IMPACT LEVEL 1 (IL 3): Projects requiring a full EIA -
Mining projects in this category are regarded as high risk. This project category involves projects has high and harsh environmental impacts whose correctional measures cannot be readily prescribed, and thus, must go through a complete EIA process. This projects category involves noticeable and harsh environmental impacts whose correctional measures cannot readily be prescribed, and thus, must undergo detailed EIA process.

Table 1: Sample Checklist: Sources of Inherent Environmental Impacts by phase (Guidelines for EIA, 2012).

	PROJECT PHASE	OPERATIONAL EVENT POSSIBLY TO RESULT IN ENVIRONMENTAL IMPACTS
1.	Construction	Construction of roads for mineral transportation and access to waste sites
		Preparation of location for the solid waste deposit. Storage of the production plant and leach waste deposit
		Construction of deviation channels production plant and leach waste deposit
		Construction of the foundations for the production plant
		Preparation of area for heap leach
		Soil removal and storage
		Preparation of area for domestic wastes disposal
		Preparation of area for domestic waste water treatment facility
		Installation of campsites, offices, workshops, storage facilities.
		Preparation of open pit area
2.	Operation	Exploitation of open pits
		Transportation of mineral to the leach pad
		Expansion and elevation of the leach pad
		Mineral leaching
		Transportation and disposal of materials in waste sites
		Reception and storage of mineral in the production plant
		Management of solutions at the production plant
		Storage of ground mineral at the production plant
		Process of mineral recovery at the production plant
		Waste disposal from the production plant
		Management of industrial and domestic waste water
		Management of hazardous materials
3.	Decomissioning (Closure and Post-closure)	Closure of open pits
		Closure of solid waste piles
		Closure of heap leach pads
		Backfill waste dump sites
		Closure of storage sites
		Closure of water and electricity sources
		Land reclamation
		Restoration of internal roads
		Re-vegetation

CONCLUSION

Every EIA (Environmental Impact Evaluation) comes up at the beginning of projects for mining or for its expansion should produce a report with EIS (Environmental Impact Statement). EIA is made to inform the public of the projects to be proposed and also to engage them in discussions about the costs (environmental and social) and the benefits in such operational event. All EIA should pass through the procedure of project proposals; screening; scoping, report drafting and review process; final report; decision making and project implementation. The different levels of EIA to help in decision making in projects are categorized into three (3) impact levels (IL); i.e. IL 1; IL 2 and IL 3.

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