

# Environmental Impact Assessment Guidelines



## Volume 3 - Mining

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## **Summary**

This manual is a result of the joint effort of the Environmental Protection Agency (EPA) and the Environmental Assessment Board (EAB). The intention is to provide to the EPA, EAB, sector agencies, private sector, NGOs, members of the public and consultants a set of approved guidelines for the conduct of Environmental Impact Assessments (EIA) for Mining Projects in Guyana.

As each project is different, EIAs will be customized to reflect issues that are relevant and specific to the project. While not exhaustive, the guidelines contained in this document are meant to compliment those in Section IV of the Environmental Protection Act, 1996 (EP Act. These guidelines should be applied consistently to projects requiring EIAs and allows for transparent decision-making.

As our understanding and awareness of the environment improve, these guidelines will be updated to reflect new ideas or issues.

## **Components of an Environmental Impact Assessment**

The EIA will comprise of three components: Environmental Baseline Study; Environmental Assessment; and Environmental Impact Statement. The Environmental Impact Assessment may be submitted as the three components highlighted above or could be submitted as one document depending on the size and nature of the proposed project.

The Environmental Baseline Study will record the present quality of the environment within the area of influence before project implementation. This data will then be analysed in the environmental assessment and will be used to predict and quantify impacts.

The Environmental Assessment is basically the identification and assessment of impacts of the proposed project and of its alternatives. The EA will also consider mitigation measures to offset negative impacts and will assess the impact of implementing these measures on the environment.

The Environmental Impact Statement is a summary of the findings of the Environmental Baseline Study and the Environmental Assessment and includes an Environmental Management Plan. For large EIAs, the EIS will be the document which decision makers and the public will use. The Environmental Baseline Study and the Environmental Assessment will then serve as reference documents to the EIS.

## ENVIRONMENTAL BASELINE STUDY

The environmental baseline should be established in suitable detail to record the environmental conditions and seasonal variability prior to development, to permit the assessment of potential effects and to provide a baseline with which to monitor future changes. The needs will vary by project and potential environmental effects but would normally encompass the following physical, biological and socioeconomic conditions.

### Physical Environment:

- **Air Quality-** Information would be required on dust fall, suspended particulates ( total and  $PM_{10}$  ) and gases such as  $SO_2$  and  $NO_x$ . Data collection techniques would include literature surveys and field data collection. For uranium extraction radon gas would also be monitored.
- **Climate and Meteorology-** Data is required on wind speed and direction, rainfall (frequency, duration, mean averages, storm events and return frequencies, Probable Maximum Precipitation), temperature and evaporation. Data collection methods include interpretation of data from nearby climate stations and in many cases installation of an on-site station.
- **Physiography, Geology and Soils-** Data is required on contour mapping, regional geology, surficial soils, soil classification and soil chemical quality where this could be effected by mining activities. Much of this data should be available from geological maps and where not available should be obtained from field studies. Soil chemistry data would be collected where potential impacts could occur from mining emissions (eg. concentrate storage and handling).

- **Hydrology-** Data on watershed areas, stream flow statistics, water levels, bathymetry, currents, hazard lands. This data is often available from published sources for large watershed but site specific data is often necessary to provide hydrologic data for the smaller watersheds normally occupied by mining facilities (plant site, waste piles, tailings basins etc.) It is common to provide water level recording and continuous stream flow monitors.
- **Hydrogeology-** Data is required on the groundwater flow patterns, aquifer characteristics (transmissivity, porosity, permeability), depth to water table, piezometric level and ground water quality. Ground water would be analyzed for the same parameters as surface water. The extent of data will be site specific and will be extensive where acid rock and tailings are stored.
- **Surface Water Quality-** Detailed characteristics of the water bodies on the lease as well as more detailed seasonal characterization of the receiving streams both upstream and downstream as well as any sub-watersheds where facilities will be built. Characterization requirements will vary but would typically include: pH, TDS, TSS, turbidity, conductivity, organic compounds (phenol and oil and grease), major anions (sulphate, chloride, fluoride, bicarbonate), alkalinity, acidity, major cations (Ca, Mg, Na, K), nutrients (TKN, total ammonia, phosphate, nitrate +nitrite), trace metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, Sb, Zn). Limits of detection should be below levels of environmental concern (normally set as levels suggested to protect aquatic species). Other elements could include bacteriological sampling (coliforms, fecal coliforms and standard plate counts), rare earth elements, radioactive elements, and other trace metals. The need for these would be determined on a site specific basis.

- **Sediment Quality-** Data are required to physically and chemically characterize sediments. Sediment sampling would normally occur at surface water sampling stations however at a reduced sampling frequency. Analyses would include organic carbon, loss on ignition, grain size, moisture content and the same metals as analyzed for water quality.
- **Seismology-** Data are required on seismicity including classification of the area, a review of seismic events, and statistics on return frequencies and design earthquakes.

#### **Biological Environment:**

- **Terrestrial and Aquatic Ecology-** A detailed inventory is required on the species within and around the mining lease. Data collection would include literature sources, interviews with local people and field surveys. Maps should be prepared. Specific emphasis is required to identify endemic plants and animals, rare and endangered species, fisheries habitat and spawning areas, benthos and plankton species and diversity and use of the terrestrial and aquatic plants and animals by people, wetland areas etc. There may be a requirement to obtain and analyze samples of fish flesh, aquatic vegetation and terrestrial vegetation to record the baseline levels of metals (notably mercury and other metals that may accumulate); sensitive ecological habitats and ecological balance.
- **Marine Studies-** Data are required on benthos, plankton, sediments, molluscs (metal bioaccumulation), salt marshes, mangroves etc. The extent and detail of such programs would depend in large part on the activity proposed and its potential effect on the marine environment.

#### **Socio-economic Environment:**

- **Socio-economics** - Data is required on: cultural/historic resources (archaeology); indigenous peoples; demographics, infrastructure; employment, income, skills and education; and public health.
- **Land Use**- All existing and proposed land use including parks, reserves, protected areas, residential, commercial, forestry concessions, eco-tourism and industrial should be described and shown as appropriate on land use plans. Specific data is required within the lease area to identify property ownership and surface rights. Effects on future development.

In the collection of data it is imperative to include a QA/QC program, submit detailed protocols for all field testing procedures and use procedure generally accepted by other jurisdictions.

## **ENVIRONMENTAL ASSESSMENT**

The environmental assessment will provide technical detail on the environmental effects of the project. The EA will focus on the proposed project but must also address alternatives. A summary of the data in the EA would be incorporated into the Environmental Impact Statement (see below). The EA should provide the following information and components;

1. Analysis of the compatibility of the proposal with the existing environmental legislation that applies to the project itself or to its area of influence. In the event that national or local environmental standards do not exist, at least two international standards must be informed.

2. Results of the regulatory and public participation program. These programs would normally include meetings, workshops, information brochures and should include consultation with NGOs, regulators, members of the public including indigenous peoples, etc. with the objective of identifying all issues and potential mitigation strategies.
  
3. Identification, description and assessment of alternatives in relation to processing, technology selection and reclamation. Provide a comparison of the alternatives with and without the implementation of mitigation measures, including the recommended alternative (from the environmental point of view). Indicate the main reasons for selection of alternatives taking into account environmental factors. Include also a prognosis of the state of the environment in each of the alternatives.
  - Site selection methodology and rationale for the proposed tailings and mine waste storage and disposal areas. Factors for consideration should include cost, minimization of environmental effects (for example land requirements, spill potential, effects on aquatic and terrestrial ecology, social effects such as loss of land for residential, agricultural or other cultural uses), long term stability and closure. Proposed methods should consider the current state of technology. Potential options and issues to explore would include: backfilling of mined pits, waste disposal in mined out underground mines and/or use of tailings as structural backfill, use of engineered liners for seepage control and the need for long term care.
  - Alternative mining and processing methods should be explored when there are potential non-mitigatable impacts to demonstrate that there are no practical cost effective alternative methods to reduce impacts and efficiently exploit the resource.

- Transportation, handling and use and substitution of dangerous, hazardous and poisonous substances such as fuels, alkalis, cyanide and mercury.
4. Detailed information regarding the methods used to analyse impacts (EIA methods) and the techniques used to estimate the magnitude of the impacts (prediction techniques).
  5. Identification, characterization, description and determination of magnitude and importance of the social distribution of the potential impacts in the short, medium and long term. Analysis of impacts must include as a minimum, direct, primary and secondary, temporary and permanent, reversible and irreversible impacts on the physical, biological, social, economic and cultural components of the environment, when applicable.
  6. Special emphasis should be placed on indirect impacts which may arise from project implementation.
  7. Assessment of physical effects for all phases including construction, operation and closure including the effects on soils; air quality – characterize and quantify all sources and model effects on suspended particulate; SO<sub>2</sub> and NO<sub>x</sub> ; noise – quantify all sources and model effects; ground and surface water quality – inventory of all contaminant sources and model effects; hydrology – model effects; and climate – greenhouse gases, physical micro – climate changes and the effects of climate change on the project if any; residual impacts. Mine waste characterization data:
    - Runoff and leachate characterization. Provide information on the potential chemical characteristics of runoff and seepage from tailings and waste rock piles. Testing protocols include field plots, column leaching tests and humidity cell tests.
    - Chemical and physical characteristics of waste rock and tailings. This would include overburden, waste rock, low grade ore and

tailings. Data should include density, grain size distribution, other physical properties required for design (eg. shear strength), mineralogy, mineral content (ICP metals and others where potentially relevant, for example mercury).

- Effluent Characterization- Data from mineralogical testing of in-plant streams and final tailings streams. The objective is to thoroughly characterize liquid streams and assess and test effluent treatment schemes. Analyses should include all metal measured in solids characterization plus process reagents and conventional water quality parameters.
7. Identify how much of a particular resource is degraded or eliminated and how quickly the natural system may deteriorate.
  8. Assessment of the biological effects on ecosystems of all project phases (construction, operations and closure). Specific emphasis should be placed on flora, fauna, rare and endangered species, endemic plants and animals, metals uptake and effect on biota and human health, effects on populations, habitat and species diversity. These aspects may in part be dealt with through an ecological risk assessment.
  9. Assessment of the positive and negative impacts on land use (compatibility), future development, cultural/historic resources (archaeology), indigenous peoples, demographics, infrastructure, employment, income, skills and education, and public health.
  10. A description of any hazards or dangers which may arise from the project and an assessment of the risk to the environment.

11. Assessment of the project with a view to the need to protect and improve human health and living conditions and the need to preserve the stability of ecosystems as well as the diversity of species.
12. An assessment of worker health and safety.
13. Detailed information regarding the measures which the proposed developer intends to use to mitigate any adverse effects and a statement of reasonable alternatives (if any), and reasons for their rejection.
14. Assessment of Mitigation Measures including cost/benefit analysis and implementation strategy.

## **ENVIRONMENTAL IMPACT STATEMENT**

The EIS will provide all relevant details on the project and its effect on the environment. This document should provide a summary level of detail adequate to allow the average reader to make an informed decision on the project. This document will include a broad range of data including information on the developer, schedule, the detailed description of the project, regulatory framework, a review of alternatives, environmental management plans, socioeconomic factors, environmental impacts, mitigation, monitoring and reclamation. The EIS would be accompanied by supporting appendices, the baseline study report and the environmental assessment which will provide technical detail on specific issues, assumptions and modelling projections. These supporting documents would be more technical.

A typical EIS report could be organized as follows:

- Executive summary stressing information regarding the potential impacts and the proposed mitigation measures.
- Introduction-overview of the project; details on the developer, ownership, the resource, company and history with mining, brief description of partners and their role in the project, description of the key components with site/land use maps; and regulatory framework and requirements.
- Detailed project description including the area of influence (spatial and temporal boundaries), location, layout, description of present land use of the project area and the area contiguous to it, project size and production, land requirements, activities associated with all development stages from construction to closure, alternatives considered, staffing and employment, emission characteristics, water supply and waste disposal, environmental/waste management plans.
  - o Location: location plans and preliminary site plans showing proposed facilities including port facilities, access roads, mining lease, mines, process plant and support facilities, accommodation facilities, water and waste management areas (tailings ponds, sedimentation ponds, waste and ore stockpiles, refuse disposal, waterways, protected areas, nearby land use, other infrastructure as appropriate (reservoirs, power lines, water supply lines).
  - o Describe the resource: geology, mineralisation, grade, proven and probable reserves, potential for expansion.
  - o Detailed schedule of activities from exploration to mine closure.
  - o Production information: production rate for mining and processing, description of the mining and processing method, reagent consumption, fuels and lubricant consumption, explosives consumption.

- Economic information regarding the project, including financial statements, budgets etc. This may be submitted as a separate document to preserve confidentiality.
- Rationale for the project and its sustainability, including consideration of alternatives to the project as well as not proceeding (no-project option).
- Existing environment – summary of information that is provided in the baseline study report
- Summary of the public consultation programme
- A statement of the alternatives selected and the justification behind each choice. Specifically address key rational and decisions for siting the processing plant, waste management areas and related facilities.
- Summary of the environmental effects. A description of the likely significant effects of the proposed project on the environment resulting from: the existence of the project; the use of natural resources; the emission of contaminants, the creation of nuisances and the elimination of wastes.
- Description of waste production (sewage, refuse, tailings, waste rock, low-grade ore, used oil and lubricants, hazardous wastes) and mine waste characteristics (chemical properties, acid generating characteristics, physical properties) and proposed management plans along with conceptual details of the design of the facilities.
- A statement of the degree of irreversible damage and an explanation of how it was assessed.

- Description of wastewater treatment process, rationale for selection, description of the best available technology, treatability studies, conceptual design of the facilities and the quality of treated water.
- Description of transportation methods, storage and handling of all materials transported on-site and off-site.
- The Environmental Management Plan (refer to pg. 15 for guidelines on preparing environmental management plans).
- An Emergency Response Plan for containing and cleaning up any pollution or spill of any contaminant. Include a review of material characteristics and hazards, credible and worst case scenarios, evaluation of hazards and risks, potential impacts and mitigation, potential liabilities, notification plans and response plans.
- Conceptual plans for progressive and final site reclamation. Proposed future land use and residual impacts, possible residual hazards and land use restrictions. The report should also include an estimate of mine reclamation and closure costs.
- An indication of any difficulties (technical deficiencies or lack of knowledge or expertise) encountered in the EIA.
- Conclusion and Recommendations
- Annexes which include the Terms of Reference, Curriculum Vitae of the members of the EIA team, document references, field observations, etc.

## **Guidelines for Preparing Environmental Management Plans**

Environmental Management Plans (EMP) are necessary to ensure that the proposed procedures, actions and measures identified as part of alleviating environmental impacts of a project are not just a statement of goodwill by the company/developer but that they will be effectively implemented.

The EMP should identify feasible and cost effective measures that may reduce potentially significant adverse environmental impacts to acceptable levels. It should also involve operational procedures needed to avoid environmental risks during everyday and maintenance operations, as well as emergency and contingency plans in case of accidents, where applicable.

Each EMP must clearly state the company's commitment and policy on the environment. There must also be a clear statement committing the company to integrate environmental management and specifically the EMP into its operation.

The preparation of an Environmental Management Plan (EMP) involves the following:

1. Environmental Policy of the company
2. Specific objectives of the plan.
3. Identification and description of the potential adverse impacts and environmental risks associated with implementation of the proposed/existing project.
4. Detailed description of the appropriate mitigation and compensatory measures together with designs, equipments description and operational

procedures (as appropriate) to respond to these impacts or to avoid or reduce risks.

5. Determination of requirements for ensuring that responses to predicted impacts are made effectively and an implementation schedule (timing) for mitigation measures that must be carried out as part of the project.
6. Development of a programme to monitor the impacts arising out of the project operational activities and the effectiveness of the proposed mitigation measures. The monitoring plan should detail as a minimum, impact indicators, location and frequency of sampling, analytical methods to be used and criteria for evaluation. Such information enables the developer and the EPA to evaluate the success of mitigation and allows corrective actions to be taken when needed. This programme should also include regular audits of the implementation of the EMP.
7. Identification of persons within the company responsible for executing the EMP
8. Identification of necessary funds (including budget) to implement mitigation measures.
9. Emergency Response Plan in cases where the project uses or produces substances known to have a deleterious effect on the environment.

The decision to proceed with a project is based in part on the expectation that the EMP will be executed effectively. Consequently, the EPA expects the plan to be specific in its description of the individual mitigation and monitoring measures which must be integrated into the project's overall planning, design, budget and implementation. Such integration is achieved by establishing the EMP within the

project so that the plan will receive funding and supervision along with the other project components.

The Environmental Protection Agency encourages companies to move towards ISO 14000 certification. ISO 14000 is an internationally accredited set of environmental standards which allow companies to achieve an Environmental Management System.