

**BMP guidelines for preparing
an Environmental Impact Assessment (EIA) Report
for Mineral Exploitation in Greenland**



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Contents

Introduction	3
The EIA report	3
The Environmental Baseline Study	6
Chemical and ecotoxicological aspects	6
Disturbance aspects	7
Guidelines for contaminants	7
References	8
Appendix 1. Guidelines for preparing an EIA for Mineral Exploitation in Greenland	11
Appendix 2. EIA details: Common Arctic features	16
Appendix 3. EIA details: Areas demanding particular attention in the Arctic	17

Introduction

These guidelines for preparing an Environmental Impact Assessment (EIA) report apply to mining companies operating in Greenland. Similar EIA guidelines have been prepared for activities regarding exploration and production of hydrocarbons.

The purpose of these EIA guidelines is, at an early stage of mining projects, to direct the mining companies' attention to environmental issues. Thereby the companies will be well informed of the Bureau of Minerals and Petroleum, Greenland Home Rule (BMP)'s environmental requirements at an early stage of a mining project. Also procedures and timetables of the EIA process in Greenland will be known to the mining companies so that this can be integrated already in the exploration phase.

The purpose of an EIA is to identify, predict and communicate potential environmental impacts of a proposed mining project in all its phases from before mine start to beyond closure, and to propose measures to address and mitigate these impacts. The effects of a project on the environment must be assessed in order to take account of concerns to ensure maintenance of the diversity of species, to maintain the reproductive capacity of the ecosystem as a basic resource for life, to protect human health and to contribute by means of a better environment to the quality of life. Exploitation should be carried out in accordance with good international practice and in a safe and environmentally acceptable manner, e.g. by using best available techniques. The EIA is site- and project specific.

Often social impacts are a part of the environmental assessment report of a mining project.

However, it has been decided not to include social aspects in these guidelines but to address social issues in specific Social Impact Assessment Report. Guidelines for such a report will be prepared.

The EIA report

An EIA report must be prepared when a company plans to exploit a mineral deposit. The EIA report must cover the entire exploitation period from mine development prior to the mine start until closure of the mine and a subsequent monitoring period. Also a period during the exploration phase should be considered as a part of the EIA, because environmental baseline studies must be initiated prior to mine start (Figure 1). Baseline studies must be performed in the pre-mining phase because the state of the environment must be determined prior to a possible impact from the mining

activities. Baseline studies must cover a period of some years before construction starts, so that the environmental variations are incorporated in the baseline description. The number of years needed for baseline studies will depend on the project and the site. Often 2-3 years of baseline studies are needed.

A detailed plan for the EIA process, including plans for baseline studies, must be forwarded to and approved by the BMP prior to the start of the EIA process.

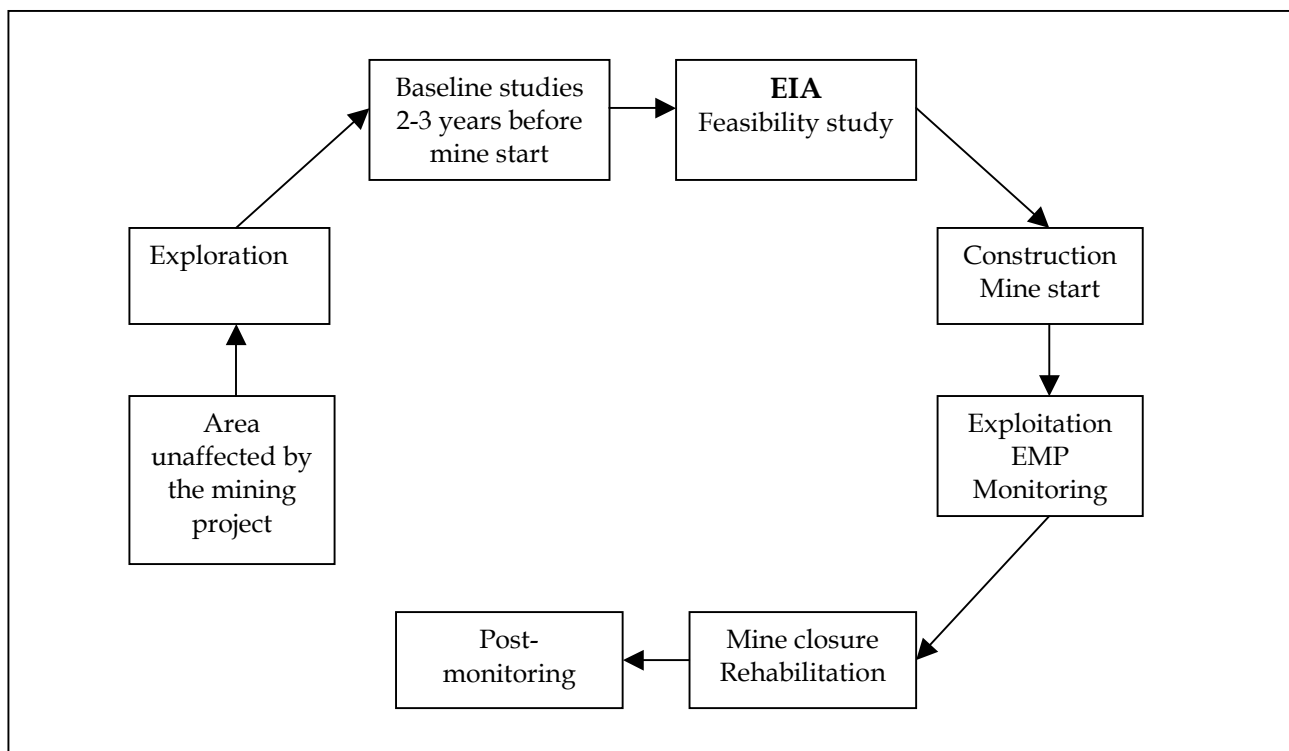


Figure 1. Environmental Impact Assessment (EIA) and its part of the history of a mining project
EMP: Environmental Management Plan

A mining company operating in Greenland must pay attention to some special Arctic features. Among these are the often relatively simple ecosystems, the slow recovery of disturbed plant communities due to slow growth rates, the slow breakdown of some contaminants, an often lack of baseline information and the use of vast, relatively undisturbed areas. Lists of special Arctic features are compiled in Appendices 2 and 3.

The following issues must be covered by the EIA:

- An **extended, non-technical summary**

- An **introduction** which describes the mine project, its background and objectives
- A thorough description of the state of the **environment** before mine start
- The **mine project** with a description of all phases from exploration to closure and beyond
- An assessment of **environmental impacts** of the project with an evaluation of alternatives compared to the preferred option
- An **environmental management plan (EMP)** which describes how the identified impacts are dealt with
- An **environmental monitoring plan** with a description of e.g. species, stations and parameters to be monitored
- The **public hearing**
- **Conclusions**
- **References** used in the EIA process and **Glossary** of terms and abbreviations

Appendix 1 outlines a proposed structure and content of an EIA.

The EIA must cover the entire region that might be affected by vehicles, airplanes and ships that can affect vegetation, animal life and local use (hunting, fishing, tourism) or by contaminants carried by dust, fresh water and sea water. If the project includes use of Greenlandic areas outside the mining area, effects of these activities must be covered as well. The EIA must be updated and further developed when needed, e.g. if there is a change in the plans presented in the EIA or a change in the composition of ore, waste or tailings. The public should be involved throughout the EIA process and informed about the activities when the mine is in production. There should be clear rules and procedures for the public involvement.

In order to secure that data necessary to produce the EIA is available, a plan for acquiring data must be prepared and kept updated. This plan should be developed in cooperation with the BMP. Sampling procedures must be approved by the BMP and sampling will be subject to inspection. NERI will keep and update a database of all environmental data collected in connection with mining activities, both from the authorities and the license holding companies. Data must be submitted to NERI in formats agreed to by the license holding companies and BMP, and will be available to both parties.

The Environmental Baseline Study

The purpose of the Environmental Baseline Study is to determine the state of the environment prior to major mining activities. Based on this often undisturbed environment it is possible to assess the environmental impacts from the mine and the activities connected to the mine.

The Environmental Baseline Study can be divided into two parts:

- Chemical and ecotoxicological aspects (pollution)
- Disturbance aspects (impacts on plant and animal populations)

Chemical and ecotoxicological aspects

The monitoring program initiated at the mine start and based on species, localities and contaminants identified at the Environmental Baseline Study should have the ability to discover unintended environmental impacts. The Environmental Baseline Study also has the ability to demonstrate abnormal metal concentrations in the environment that are related to natural processes and not to the mining activities.

As mentioned, the Environmental Baseline Study must be initiated some years prior to mine start. The reason is that the study must be performed in an environment not affected by the mine and that the often rather large environmental variations that occur in the Arctic are incorporated in the baseline description. Especially when metal concentrations in fresh and sea water are assessed it is important to collect samples in different seasons.

Sampling localities, here called stations, should be located in a web with the centre placed close to the mining activities. Most stations should be placed near the mine, the process plant, and other important activities. Stations should be placed wider apart when moving from the centres to about 10 km from these (e.g. along a coast, in-land or along rivers and lakes). Further away from the centres, maybe up to 40-50 km away, few reference stations, i.e. undisturbed stations, should be placed. It is important when collecting samples to monitor impacts from dust to take prevailing wind directions into account.

Samples collected during environmental baseline studies may not be analysed right away but can await decisions on mine start or the start of the EIA process. The samples collected or a second set of these must be issued to an environmental sample bank administered by National Environmental

Research Institute (NERI), a scientific advisor of the BMP. A plan regarding necessary samples to be stored should be developed in cooperation with the BMP.

In the pre-mining phase it is also important to carry out studies on the chemical composition, the acid generating potential and the ecological toxicity of ore, waste and tailings. A test production of a bulk sample in a pilot plant will often give the necessary knowledge of these issues. It is important to emphasize that if the chemical composition of the bulk sample differs significantly from the mined ore and the waste then new studies should be performed. According to the chemical composition of ore, waste and tailings it is possible to target the chemical analyses on the biological and non-biological (sediments, water and dust) samples.

Disturbance aspects

A mining project will affect plant and animal life. The degree of impact will depend on the project and on the plant and animal communities. Therefore baseline data about plant and animal life must be presented in the EIA. Such information also makes it possible to mitigate possible impacts. Some of this information is available as local knowledge. In the pre-mining phase it is important to conduct a local knowledge study aimed at mitigating conflicts between the local use of the area for hunting, fishing and tourism and the mining activities. Such a study can be performed as an interview study where a representative group of hunters, fishermen, tourist organisers, local industries etc. are interviewed according to prepared questionnaires and maps. Feedback mechanisms should be an integrated part of such a study.

A detailed list of contents of the Environmental Baseline Study must be forwarded to BMP for approval prior to the start of the baseline study. This includes topographic maps showing the localisation of proposed sampling stations. BMP can claim that issues not mentioned in the contents be included in the Environmental Baseline Study.

Guidelines for contaminants in the environment

In general, the best available techniques should be used by mining companies to reduce or avoid environmental impacts. But also guidelines on acceptable contaminant levels in the environment should be consulted in order to minimise or avoid acute and chronic effects in the environment. By including in the EIA environmental guidelines for relevant contaminants in different environments and food items, and from different countries, it is possible to compare concentrations in analysed samples to recommended maximum concentrations in the ecosystem. Thereby all parties should be well informed of when actions have to be taken to ensure a safe environment around the mine site.

Because guidelines from different jurisdictions may differ, it is important among relevant parties to discuss which guidelines are preferred and why. Also, guidelines do not exist for all contaminants and all organisms, so it is important to identify lacking knowledge and how to cope with that. A possibility would be to initiate studies related to the specific mining operation.

Greenland authorities have not developed guidelines on acceptable contaminant levels in the environment specific for Greenland. Guidelines must therefore be adopted from other jurisdictions. Greenland is situated in the Arctic and therefore it is natural to adopt guidelines from other Arctic countries or jurisdictions such as Canada. Since Greenland is closely related to Denmark it is obvious to adopt guidelines from Denmark. Because Denmark is an EU member state many Danish guidelines have been implemented from EU guidelines. Which guidelines to choose must be agreed upon with the BMP.

References

In developing the guideline presented in Appendix 1, information on the requirements for an EIA report related to mineral exploitation in other countries and in Arctic countries have been studied. Valuable information was found in:

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Appendix 1. Guidelines for preparing an EIA or Mineral Exploitation in Greenland

The following is a gross list of issues to be considered when preparing the EIA report. All chapters must be dealt with in the EIA, but not all bullet points may be relevant to the specific mine project. A detailed list of contents of the EIA must be issued to BMP for approval prior to the start of the EIA process. BMP can claim that issues not mentioned in the contents be included in the EIA.

Environmental baseline studies must be initiated prior to mine start and should be considered a part of the EIA. Baseline studies must be performed in the pre-mining phase because the state of the environment must be determined prior to a possible impact from the mining activities. Baseline studies must cover a period of 2-3 years before construction starts, so that the environmental variations are incorporated in the baseline description.

Social aspects are not included in these EIA guidelines.

1. Extended summary

A non-technical summary describing in short the project and a conclusion including preferred options compared to alternative solutions, important potential environmental effects, mitigations, decommissioning and remediation, uncertainties and public concerns. The summary should be presented in Greenlandic, Danish and English.

2. Introduction

Description of the mine project, background and objectives

- Description of the mining company
- Geographical placement of the mine activities with presentation on regional and local maps
- Description of geography, geology, climate, environment, local population etc.
- Background and objectives of the mine project
- Advantages and disadvantages for the region. Implications of the project not being carried out
- Description of alternatives (approximately given the same extent) to the proposed project, e.g. tailings placement, infrastructure
- Timetable for construction, mine start and operation
- Mineral Resources Act and other relevant legislation

3. The environment

A comprehensive description of the environment before the mine start

- Detailed description of climate, geology (e.g. earthquakes), geography (e.g. fast ice and ice bergs, avalanches), freshwater and sea water quality and hydrology
- Baseline concentrations of metals and of other pollutants
- Flora and fauna (e.g. rare and sensitive species) with distribution of vegetation communities and animal populations
- Important areas to wildlife (BMP designated areas), preserved areas (e.g. National Parks, Ramsar sites) and others
- Local inhabitants and their use of the area (for e.g. fishery, hunting, livestock, urban development)
- Tourism
- Archaeology

4. The project

This chapter contains all phases of the mine project from exploration to closure, including decommissioning and rehabilitation. Included are illustrations, diagrams and maps with plans in the description

- Overview of mineral exploration in the area performed to date
- Description of planned processes, plant facilities, vehicles, possible mine expansions and demands, handling and storage of reagents and explosives
- Energy demands (energy sources: oil, gas, hydropower etc., and quantities) and storages
- Gas and dust emissions including the amount of greenhouse gases
- Water supply (quantity, sources, demand in percent of source, disposal)
- Workforce, accommodation, human waste, rubbish and sewage
- Tailings, waste rock and discharge water
- Transportation to and in the mining area (e.g. harbour, airstrip, roads)
- Storage of tailings and waste rock (stability of dams and pits)
- Alternatives to the project
- Close down and decommissioning of the mine
- Rehabilitation of the mine area, including a description of permanent changes introduced to the mine area

5. Environmental impacts and mitigations

The criteria used to assess the different impacts should be clear and effects should be quantified where possible. It is here important to include the environmental impacts from the alternative possibilities identified in chapter 2 and 4, and compare these to the preferred options. Issues where information is lacking, incomplete or uncertain should be identified. Long and short term effects during development, operation, during and following mine closure should be considered. Effects of possible malfunctions or accidents must be described. Topics that do not require further attention should be specified. If the project is likely to have a significant effect on a neighbouring country these effects must be described and the neighbouring country informed as soon as possible during the EIA process.

Physical

- Area impacted and possible landscape disturbed
- Erosion (land, river banks, costs along fjord etc.)
- Hydrological changes of rivers, lakes and fjords
- Qualitative and quantitative impacts on freshwater and sea water (e.g. increasing turbidity)
- Dust
- Noise and vibrations
- Light, heat and radiation

Ecological

- Pollution from ore, tailings and waste rock (studies on e.g. chemical composition, leaching elements, acid drainage, toxicity on species from different genera and bioaccumulation, greenhouse gases, human health)
- Removal or damage of vegetation and effects on possible carbon sinks
- Disturbances of wildlife (degree of impacts on breeding, moulting, feeding and migration sites; some species may be attracted by the mine activities)
- Loss of habitats
- Loss of biodiversity
- Introduction of non-native species of flora and fauna
- General impact on ecosystems
- Creation of new habitats

Local use

- Impediment of other land use, e.g. for hunting, fishery, conservation, other mineral resources, and tourism
- Increased demand on existing resources such as water
- Open up the area for other land use through major changes in infrastructure (e.g. building of roads, harbours, airstrips, houses and power supply (e.g. hydropower))
- Cumulative impacts: An evaluation of the impacts caused by the activities of all operators in the region and in combination with the development in other human activities in the area (e.g. fishing and hunting)

6. Environmental management plan (EMP)

Describes in detail how the mining company intends to reduce the different identified impacts and how effective the measures are. Impacts should be reduced by using best available techniques. It is assessed if the residual effects, after mitigating measures have been introduced, are significant and adverse. Compensatory measures are in those cases included in the EMP. Often the EMP develops during the lifetime of the mine due to the assessments and feed-back of e.g. the environmental monitoring. The EMP describes as detailed as possible how the mitigating measures are organised and who is responsible for carrying out the mitigatory and monitoring measures.

7. Environmental monitoring

Describes which parameters and species are monitored, identified from the environmental impacts identified in the EIA process and the findings in the environmental baseline study. How often is the environmental monitoring study performed, analysed, reported etc. The report assesses the results, compares where possible the results with environmental guidelines and proposes necessary changes in monitoring and in mine management plans and procedures. Monitoring of greenhouse gases are included if emissions are considered significant.

8. Public involvement and comments

Comments from the public hearing of an EIA draft report are evaluated and included in the final EIA. A description is given on the information received and how it was incorporated in the report. Included in the final EIA is also a list of persons, institutions, organisations etc. who was consulted and who commented on the draft report. The public should be involved throughout the EIA process

and informed about the activities when the mine is in production. There should be clear rules and procedures for the public involvement. If the project is likely to have a significant effect on a neighbouring country, this country must be informed likewise the national public. All data collected in connection with the EIA, with baseline and monitoring studies are made available to the public.

9. Conclusions

Describes the preferred options compared to alternative solutions, important potential environmental effects, mitigations, decommissioning and remediation, uncertainties and public concerns.

10. References, authors and glossary

The glossary explains the terms used and contains a list of abbreviations.

Appendix 2. EIA details: Common Arctic features

Derived from Arctic Environmental Protection Strategy 1997: Guidelines for Environmental Impact Assessment (EIA) in the Arctic, Finnish Ministry of the Environment, Finland, 50 pp.

Climate, geographic and geological features

- extent of ice-cover on waters
- typified by cold areas (cryosphere)
 - permafrost
 - periglacial features
 - glaciers/ice sheets
 - stored greenhouse gases such as CO₂ and methane
 - stored fresh water
- sink for airborne/waterborne pollutants
- slow break down of contaminants
- large variations in conditions between years

Ecosystems and biological resources

- young ecosystems and numerous sensitive areas (see Appendix 4)
- sharp gradients in the environment and ecosystems both in time and space
- short food chains
- slow recovery/regeneration rates
- risk of irreversible processes/cascades (e.g. as consequence of erosion)
- low carrying capacity
- high concentration of stocks (groups of certain species)
- biodiversity at genetic and landscape levels
- unspoilt landscapes that are large enough to allow ecological processes and wildlife populations to fluctuate naturally

Socio-cultural and economic features

- cultural variability: indigenous/other local
- high percentage of local inhabitants are dependant on renewable resources
- extensive (vs. intensive) patterns of land use –hunting, fishing
- areas of very low to very high population densities
- growth of industrial development and exploitation of non-renewable resources

Knowledge of the systems

- limited baseline environmental knowledge
- traditional knowledge

Appendix 3. EIA details: Areas demanding particular attention in the Arctic

Derived from Arctic Environmental Protection Strategy 1997: Guidelines for Environmental Impact Assessment (EIA) in the Arctic, Finnish Ministry of the Environment, Finland, 50 pp.

Areas or sites of potential great sensitivity or unique geomorphological characteristics:

- permafrost terrains and insulating layers, especially unique permafrost land forms
- wet tundra
- coastlines
- soil and waters prone to acidification, in some cases alkalization
- dunes
- ice-edges, polynyas
- glacier rivers
- glaciers, eskers

Areas of special importance to wildlife:

- fish spawning and nursery areas
- nesting, rearing and staging areas for waterfowl and other birds, e.g. bird cliffs and colonies
- calving areas for caribou and muskoxen
- marine mammals migration routes
- denning areas for polar bears and rearing areas for other animals
- seal pupping areas
- walrus haul-out sites

Areas with valuable, sensitive and representative biotopes:

- snowbed habitats
- tundra heaths
- vegetation on scree slopes
- hot springs and lakes with unique flora and fauna

Areas of spiritual, cultural and other socio-economic value as well as areas of special importance for traditional resource use:

- sacred and spiritual places
- burial grounds
- traditional fishing or hunting campsites
- traditional trails
- marine mammal harvest areas