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MAIN POINTS OF THE ADVICE

The Commission for Environmental Impact Assessment considers the following points in its advice as crucial in the Environmental Impact Statement (EIS) for the Margo Mining gold mine project in Suriname:

- An analysis of the current practices and problems of gold mining in Suriname on land and on rivers and creeks and its impacts on the socioeconomic and natural environment.

- An overview of the anticipated environmental effects of exploration activities, which will be executed by Margo Mining.

- A description of the intended mining and processing methods which are effective and minimize the environmental impacts, with emphasis on:
  - enhancement of gold recovery;
  - processing methods without the use of chemicals like mercury;
  - measures to ensure safety and security during operations.

- An overview of mitigation measures like measures to avoid the direct discharge of process water with slimes on the surface water and measures to minimize emissions.

- A plan for rehabilitation of the mined out areas, including conditions for proper mining set by the rehabilitation plan.

- A description of the impacts of the proposed gold mining project on the socioeconomic situation, both in terms of an improvement due to new employment opportunities and use of safer methods for gold mining and in terms of negative impacts like reduced visibility for navigation purposes,increased risk for malaria or threatening of fishery.

- With reference to public involvement the EIS should provide:
  - a scheme for on the job training of miners in small scale gold mining and exploration methods that are effective and environmentally sound;
  - suggestions how to organize a public awareness campaign on the health and environmental effects of the use of mercury for the miners and local population.

- Recommendations for monitoring and evaluation of the environmental restrictions on the mining operations, of the environmental impacts of mining and of the results of the plan for rehabilitation of the affected areas.

1. INTRODUCTION

Margo Mining N.V., a registered company in Suriname, requested the Netherlands to finance an environmental study for the development of a gold mine in the area of the Marowijne river in Suriname. The company has acquired three concessions with a total area of approximately 46.000 ha, distributed over three sites (see map, appendix 5). Margo Mining has the intention to realize their mining activities in an environmentally friendly way.

In Suriname, the Ministry of Natural Resources, through the Geological Mining Service (G.M.D.), is the responsible authority concerning the granting of mineral rights. For gold mining there are three types of mining rights, namely reconnaissance rights, exploration rights and exploitation rights.
The G.M.D. granted three 'right of reconnaissance' areas to Margo Mining N.V., namely Adelaars Top (25.430 ha), Gran Kreek (14.807 ha) and Paramacca Kreek (6.000 ha). At the end of the reconnaissance phase (phase 1), one of the areas will be selected for further exploration. At the end of the exploration phase (phase 2), the exploitation area (mine site) will be selected for gold mining. Margo Mining applied for exploration rights for all three areas. Their intention is, however, to start exploration in one of the three areas. With the revenues of the exploitation in the selected area, further exploration will be done. If the exploration results of the selected area are negative, exploration may be continued in the second area later on and afterwards possibly in the third area. Based on the results of the reconnaissance phase, in January 1996 Gran Kreek has been selected to start exploration. A decision on exploitation will be taken in October 1996. If Margo Mining applies for an exploitation right, they will have to submit an Environmental Impact Statement (EIS) to be approved by the Minister of Natural Resources based on the existing Mining code[1]].

The Environment Programme (DST/ML) of the Directorate-General International Cooperation decided to support the initiative by financing the scoping of an Environmental Impact Assessment (EIA). The EIS will be written during the exploration phase and will form the basis upon which a decision on investments through IFC/FMO[2]] or others can be taken. Field activities to collect data for the EIS will have to be combined as much as possible with exploration.
The EIS is restricted to small and medium scale activities.

1 It is worth mentioning that the Ministry of Natural Resources is renewing the mining code of 1986. The new mining code will provide a simple, clear understandable and stable set of laws and regulations which assume protection of the environment, easy access to mineral rights, transferability of mineral rights, legal recognition as a basis for enabling the development of small, medium and large scale mining.

2 IFC, International Finance Cooperation.
FMO, Nederlandse Financieringsmaatschappij Ontwikkelingslanden.

Mining is an activity which, according to OECD-standards (Organisation for Economic Cooperation and Development) and international loan agreement conditions, is subject to EIA. Objective of the EIA in support of this project is to provide both competent authorities in Suriname and the Netherlands and other parties, interested in financing the exploitation, with relevant information on the environmental effects of the project in order to foster an environmentally-sound, socially acceptable, economically feasible and well-informed decision making process.

More specifically, the EIS will contain information on:

1. The environmental effects of exploration. As the exploration rights already will have been granted while the EIS will be drawn up, environmental information on exploration is not relevant anymore for decision making. However, as this initiative possibly will form an example for other gold mining activities, a description of environmental effects of exploration including mitigating measures is considered to be important and will be asked for in the Terms of Reference.
2. The environmental effects of and alternatives for exploitation, taking into account geotechnological, environmental and socioeconomic criteria[3]]. This information is relevant for decision making on the exploitation rights.
3. A plan for rehabilitation and the implications for the mining process.

A decision on site selection between the three areas already has been taken based primarily on the presence of gold in economically feasible quantities. Moreover, no evidence is found until now of important differences in the presence of unique ecosystems and/or species within the three areas, which would have justified the incorporation of a chapter on 'site selection' in the EIS. Therefore, this advice will be restricted to the above mentioned subjects. In paragraph 5.3, the Commission will make some general remarks on the selection of the location for mining.

In a letter dated 24th January 1996 (see appendix 1), the Netherlands Minister for Development Cooperation has requested the Commission for Environmental Impact Assessment in the Netherlands to advise on Terms of Reference for the preparation of an Environmental Impact Statement for the project involved. As a first step in the procedure, Margo Mining prepared a Notification of Intent.

The advice has been prepared and will be submitted to the Netherlands Minister for Development Cooperation by a working group of the Commission for EIA. The working group consists of independent experts of Surinamese and Netherlands nationality. The composition of this working group is presented in appendix 2 together with project information. The following disciplines are represented: geology, gold mining technology, toxicology/health, ecology, sociology.

3 These Terms of Reference do not have a gender-specific approach, because it is not applicable for the Margo Mining initiative.

During the preparation of the advice, the working group visited the project area and discussed with several governmental and non governmental authorities and agencies in Paramaribo in the period 15 – 22 February 1996. The programme of the site visit is presented in appendix 3. Purpose of this visit was to collect information on the project in order to enable formulation of a project and site specific advice for Terms of Reference for the EIS.
In this advice, the Commission has taken into account as far as possible the opinions of affected people and relevant stakeholders involved.

Herewith the Commission wishes to express its gratitude for the excellent support and courtesy extended to the Commission by the various organisations in Paramaribo and by the Granman and his Chiefs in the project area during this visit.
The Commission would like to express special thanks to Mr Brands of the Netherlands Embassy in Paramaribo and to Mr Wolly of Margo Mining.

2. PROBLEM ANALYSIS AND PROJECT OBJECTIVES

2.1 Problem analysis

According to the Notification of Intent, actually in the project area two methods of mining are being used by the small scale miner: hydraulicking and suction 'dredging'. The first one is used for gravel deposits on land and in creek valleys, the second for gravels on the river beds. Both methods are characterized by a low recovery, because of inadequate processing and management. In almost all cases the small scale miner does not know what to expect in the material he decides to mine. Unnecessary deforestation and damage to the river banks with no economic justification are the result and exploration is seriously hampered.
In the enrichment process mercury is used, which is allowed to flow into the river and to evaporate into the air.

The above section summarizes briefly the problems in the area. The EIS however, must state in clear terms the problems which are assumed to be solved by realisation of the project.

In the problem analysis at least the following aspects should be addressed:
- description of living conditions of the people involved in small scale mining activities (public health situation, e.g. occurrence of malaria, the acute and long term effects of use of mercury for the individual worker and for the population in general, safety and security aspects in relation to the value of gold);
- impacts on the environment by the actual mining activities, e.g. contamination of water, soil and air, destruction of the vegetation, damage to the river bed and terraces, stream siltation by mining activities (discharges of slimes), effects on aquatic and wildlife resources;
- origin, need for and development of the proposed activity: relationship to gold mining activities (both small and large scale) in the past and present in Suriname;
- processing of tailings containing mercury;
- lack of control mechanisms for the mining activities;
- lack of proper management of gold resources.

2.2 Project objectives

According to the Notification of Intent the main objective is to minimize the environmental impacts of gold mining, thereby improving upon the resource management as well as the socioeconomic situation in the area by creating an economic nucleus.
The short term objectives have been formulated as:

- to investigate the presence of sufficient alluvial reserves to sustain an operation that warrants the expected investment;
- to ensure that the exploration and exploitation offer the opportunity for on the job training for those directly involved and those who wish to be involved (third parties).

The proposed activities could thus provide guidelines for other intended projects in the region. These projects could then become the centres for further development.

The EIS must contain a clear definition of the objectives of the proposed activity to enable identification and formulation of alternatives and to furnish criteria for monitoring and evaluation. These objectives should logically ensue from the problem analysis, mentioned in the preceding paragraph.
Objectives should be formulated in such a way that identification of alternatives – meeting the same objectives – remains possible.
Finally the objectives should be as specific as possible and where possible quantified.

3. PROJECT SETTING

3.1 Legislative and regulatory considerations and policies

The EIS must describe national laws, rules, regulations and policies concerning the proposed activity[4]]. These include the following:

- policies, legislation, regulations and standards governing environmental quality (water, soil, air if any), health and safety, industrial health, protection of sensitive areas (at regional and/or local level);
- land control or land administration (land rights, traditional or otherwise);
- an assessment of the probability of compliance with above-mentioned agreements and of law-enforcement;
- mining law and regulations and law-enforcement;
- duration and validity of licences for exploration and mining;
- Accord for National Reconciliation and Development (8 August 1992).

As the proposed activity may have co-boundary effects (the Marowijne river forms the border), the laws, regulations and policies of French Guyana have to be taken into account, where relevant.

3.2 Institutional context

The EIS must give a clear description of the institutional framework on the national (governmental agencies) and local (district commissioner and Granman) level, including the mode of cooperation with competent authorities directly involved in the execution of the project and the control of the executed works. Special attention must be given to the institutional capacity of the Geological Mining Service in relation to the mining law-enforcement and to the establishment of local gold centres in the interior for inspection, training and buying of gold (decentralisation).

4 Current legislation as well as plans for future legislation, e.g. the proposed new Mining code.

3.3 Public involvement and the role of non governmental organisations

The EIS must contain a description of the stakeholders in the project and how their opinions and interests did influence the contents of the EIS[5]].
The Commission recommends that the views of affected groups and local NGOs are fully taken into account in the preparation of the EIS. Community involvement is important in order to:

- understand the interest of local people in current small scale mining and to assess the nature, extent and importance of potential (direct and indirect) impacts;
- assess the suitability and acceptability of the proposed mining activities and of various measures that might prevent or mitigate impacts.

The EIS must also indicate in which way the inhabitants of the area are involved in the project design and the development of alternatives as well as project execution.
NGOs, whose activities have to be taken into account in the EIS are the Foundation for Experimental Mining (on the job training), the Stichting voor een Schoon Suriname, the Stichting Humane Toxicologie in Suriname and the Medische Zending Binnenland Suriname (awareness campaigns).

4. DESCRIPTION OF THE ENVIRONMENT AND ITS AUTONOMOUS DEVELOPMENT

4.1 General

The EIS must contain a description of the current situation of the environment and its development if no mining project will be established (the autonomous development or reference situation). This description serves as basis for the comparison of the environmental effects of the various alternatives. The description must be limited to those aspects that may be influenced by the activity and must cover the three mining areas, as well as the areas of influence. These areas may differ per aspect. The study areas must be indicated on maps. The description must be based on information which is available in existing documents and information gathered during exploration activities[6]].

4.2 Natural environment

The following aspects must be addressed:

- topography;
- a survey of the geology and morphology of the three areas involved;
- an overview of former gold mining activities;
- a description of the river and creek discharge pattern;
- existing erosion and its effects downstream;
- surface water and sediment quality (suspended solids, dissolved organic matter, presence of sulphides, microbial activity of sediments, mercury and speciation contents in solution and sediments, pH/conductivity/redoxpotential, mineral oils);

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5 It is now well known that small and medium scale mining in Latin-America, Africa and Asia makes an important contribution to national and regional rural development in developing countries. To realise its full potential mining needs to be sustainable and safe. In order to ensure its success, positive action will have to be taken by all those concerned, including governments, mining companies, national and international development assistance agencies. Areas for action are legal, financial, commercial, technical, environmental and social. The EIS has to take into account this context.

6 At the moment this is only possible for the Gran Kreek area. For the other two areas a synthesis of the available information must be presented in the EIS. Information from fieldwork during exploration activities will have to be presented in a later stadium.

- the collection of data on the potential risk of mercury oxidation, mercury methylation and mercury uptake by fish in the food chain;
- mercury contamination in the past;
- soil conditions and characteristics, with special emphasis on the vulnerable top layer;
- composition and quality of the river and creek bed and valleys;
- flora and fauna (see remarks of the Commission in section 5.3):
  - description and mapping of forest types;
  - listing of commercial, subsistence and endangered species[7]], characteristic for the described forest types;
  - listing of commercial, subsistence and endangered species characteristic for aquatic environments;
  - protected areas near or downstream of the project area.

4.3 Socioeconomic environment

The EIS must contain a brief description of:

- total population in the area;
- population density, growth, pressure on land;
- employment situation;
- economic active population and kind of activities (e.g. fishery, mining workforce, agricultural land use);
- formal and informal landownership in the area;
- existing concessions in the area;
- living circumstances and health services;
- actual health and environmental risk situation, related to existing gold mining activities (see also problem analysis, section 2.1);
- current practise of gold trading system (legal, smuggling);
- informal and formal organization structure of the inhabitants;
- accessibility and (public) transport;
- actual and potential roles of men and women in the area;
- sites of historical/cultural significance, e.g. Gran Kreek.

5. DESCRIPTION OF THE PROJECT AND ALTERNATIVES

5.1 General

The project aims to develop a mining activity that is sustainable from an environmental and socioeconomic point of view. Therefore, the Commission recommends to pay special attention to the concept of sustainability in the description of the project in the EIS. This can be done through a chapter on the concept of sustainable mining[8]] but also through the incorporation into the EIS of

7 Vegetation studies and flora inventories may be carried out at any time of the year, however, fauna studies (aquatic resources and wildlife) should at least be investigated twice: during the long rainy season (April – August: preferably in June) as well as during the long dry season (August – November: preferably in October).
In case not earlier recorded ecosystems and/or species are found, their uniqueness should be further investigated by exploring comparable habitats surrounding the exploration area. In case there is an indication for any uniqueness, in this phase the result may produce an effect on the final mine site selection.

8 Sustainable mining also includes proper management of mineral resources.

a plan to rehabilitate the affected environment. This is of great importance because this project may form an example for other gold mining activities in Suriname (see 5.5.5).

The proposed project consists of two components:

- Exploration phase: objective is to obtain sufficient information to be able to decide whether and where mining operations can be developed and which type of mine (small, medium or large scale) will be feasible. This not only depends on whether the valuable material occurs and in which quantity, but even more on the distribution and nature of occurrence. Taking into consideration financial, logistical and technical aspects, Margo Mining intends to establish as a first step a small scale operation. During exploration, areas suitable for small scale mining should be identified and demarcated to ensure that there is no interference with areas that can only be exploited on a large scale. By using proper exploration techniques, damage to the environment has to be minimized.
- Exploitation phase: provided the exploration results are positive, these will be used in the development of mining methods and methodology, the selection of processing methods, tailings disposal, discharge of process water and rehabilitation of the mined out area.

The first group of activities will take about six to nine months, while the second group of activities will be actually implemented when a decision on continuation of the project has been taken.

5.2 Project activities, alternatives and mitigating measures

Section 5.4 and 5.5 indicate which aspects of the proposed activity have to be described in the EIS. The choice of the mining and processing method and the selection of equipment must be substantiated. Alternatives for different parts of the activity can be developed and have to be described including their environmental effects. Paragraph 5.6 will describe the so called 'no action' alternative and 'no-action plus' alternative. Another alternative which has to be considered in the EIS is the alternative most friendly to the environment (5.7).

Mitigating measures to prevent or reduce negative environmental effects during the exploration and exploitation must be described as well. Suggestions for a description of mitigating measures are mentioned in section 5.5, however other measures can be developed in the EIS.
The mitigating measures can be undertaken individually or combined into an action plan.

5.3 Selection of location

The government of Suriname granted three gold mining 'Right of Reconnaissance' areas to Margo Mining N.V. At the end of the reconnaissance phase (phase 1), one of the areas will be selected for further exploration. At the end of the exploration phase (phase 2), the exploitation area (mine site) will be selected for gold mining. As the decision on the selection of the first location for exploration already has been taken by Margo Mining, a motivation and criteria for the selection of Gran Kreek have to be given in the EIS. These criteria may be amongst others:

- gold mining potential;
- existence of former tailing fields;
- hydrology (availability of process water during dry seasons);
- availability of human resources and potential positive impact of mining activities on nearby local communities;
- logistics, accessibility.

Ideally, both selections should (also) have been based on the results of ecological baseline studies. However, the decision at the end of phase 1 has already been taken. The Commission has the

opinion that no great risk has been taken from an environmental point of view, because of the reasons mentioned below.

Presently, the 46.000 ha of Margo Mining reconnaissance areas are uninhabited and covered with a variety of tropical rainforest types (like primary high dry land forest, primary marsh forest, primary creek forest and several types of secondary vegetation).
The Paramacca Creek and the Gran Creek concessions are situated in the lowland part of the Marowijne drainage basin (with elevations less than 100 m + NSP), the concession area Adelaars Top is situated in the upper (highland) part of the Commewijne drainage basin with elevations up to 400 m + NSP.

Biodiversity data from the potential mining areas are scarce to completely lacking[9]]. The areas are hardly accessible. Ecological baseline studies in large reconnaissance areas will be very costly and time consuming which in turn may result in a serious delay of the project.
Based on the current biogeographical knowledge of the interior area of Suriname, there is no reason to expect a significant differentiation in unique ecosystems and/or species between the three reconnaissance areas.

5.4 Exploration

In order to reach maximum effectiveness, the exploration programme should be part of the EIA. The EIS must describe methods and equipment used for exploration purposes as well as their environmental effects, to determine:

- the occurrence, quantities, distribution and nature of occurrence of gold;
- the vulnerability of the ecosystem[10]];
- the suitability for gold mining from a socioeconomic point of view[11]].

The exploration is focused on the identification, mapping and evaluation of deposits suitable for small and medium scale mining. In general this means placer deposits at or near the surface (until a depth of 5 meters). Indications for large scale deposits should be reported. The exploration programme consists of the following activities:

- A survey of existing information on the three concession areas to identify zones of interest and zones that may be discarded.
  The concession areas have to be indicated on topographical maps (scale 1: 10.000), as well as the total surface involved.
  Al the existing information relevant for the gold potential of these areas should be compiled (e.g. from reports, maps, aerial photographs, airborne geophysical data, satellite images et cetera) and indicated on maps.
  This information includes:
  - gold workings, tailing fields and production data from the past;
  - results of former exploration (e.g. by the G.M.D.);
  - river and creek gravels, terraces and other placers at or below the surface;
  - areas favourable for gold mineralization based on geological and geophysical data.

9 In January 1996, on request of the Nature Conservation Department of the Surinamese Forest Service and of the Foundation of Nature Preservation in Suriname, the formulation of a project document was financed by the Dutch government to carry out an inventory and mapping of the ecosystem of the interior of Suriname to select and establish a system of representative protected areas.

10 Not applicable for the Margo Mining initiative, as explained in section 5.3.

11 Idem.

- Scout prospecting to delineate zones with goldbearing gravels.
  This means sampling of gravels from second order creeks at regular intervals (e.g. 500 metres) and above confluences. The grades at each sampling site are estimated by panning and indicated on maps. Deeper gravels are sampled by digging a few testpits.

- Detailed exploration leading to the selection of mining blocks.
  This is done by pitting or shallow auger drilling at close intervals along a grid net and determining the gold content at each site. At suitable locations trenches are made. The following aspects should be addressed for each deposit:
  - estimation of minable reserves;
  - depth, volume and type of overburden;
  - characteristics of gravels such as grainsize distribution and clay content;
  - shape, grainsize and distribution of gold particles;
  - mapping of former tailing fields;
  - content and nature of mercury in tailing fields.

- Processing tests of gravels in a small pilot plant
  These tests are needed to obtain parameters for processing in the exploitation stage.

5.5 Exploitation

5.5.1 **Mining process and transport**

In the EIS the following aspects have to be described:
- method and equipment for mining (e.g. floating dredgers, shore-based draglines, jets of water that wash out the gravel material, sluices to collect and direct the runoff, Knelson bowls, vibrating screens, shaking tables, retorts);
- total volume to be excavated and amounts of valuable material, being gold and materials which can be used for rehabilitation;
- measures taken to separate valuable material at the mining site and delimit the need for haulage;
- means of transport of the mined material from the mine to the treatment plant, including e.g. trucks, scrapers, shovels, draglines, bucket wheels, bulldozers;
- distance of transport;
- location of treatment plant;
- location of settling ponds;
- measures taken to separate topsoil in such a way that it can be retrieved for reclamation purposes;
- need for and location of (temporary) stockpile(s) for e.g. topsoil, oversize material and tailings;
- measures to be taken at the stockpile site(s), preparation of the area and the clearing of the site;
- anticipated measures to be taken for the excavation sites in relation to recovery/rehabilitation, e.g. determination of amount and surface of mining blocks (small plots at random, big plots, strips, sequence and phasing of excavation sites in the area);
- measures to delimit the discharge of silt into the river/creek;
- description of safety and security measures during the mining activities;
- availability of skilled and manual labour in the area and whether workers from other communities, including additional local services, will be required;
- proper mine management.

5.5.2 Treatment

In the EIS the following subjects have to be covered:

- capacity and flexibility of the treatment plant, in relation to the quantities and composition of the available material and the intended use by third parties in the future;
- physical impacts of construction of the treatment plant and related infrastructure (service roads, buildings);
- the proposed system, for normal and special (maintenance and calamities) exploitation situations;
- a process scheme, including necessary inputs (e.g. water supply, fuel supply, applied chemicals) and expected outputs;
- character and quantity of the use of energy and other resources as well as measures for energy and raw material saving;
- description of the operation and maintenance of the system as well as training requirements on these matters.

5.5.3 Transport and disposal of outputs

The EIS has to describe:

- quantities, composition and character of outputs, distinguished for valuable and rest material (tailings, discharge of slimes, spoil);
- measures to warrant recycling and useful application of materials (e.g. tailings and the use of sand and gravel for rehabilitation of the mined out areas, settling ponds);
- destination and guarantees for transport;
- marketing and trading;
- transport infrastructure and equipment.

5.5.4 Emissions

The EIS must give an overview of emissions due to processing and transport, including measures to reduce or prevent these emissions. The following items must be described:

- the release of polluting agents like mercury from tailings of former mining activities and measures taken to reduce its emissions (e.g. through the use of retorts);
- spills of fuel and mitigation measures taken (e.g. oil separation);
- origin, quantity and quality of waste- and process water; it has to be indicated with help of a flow scheme if and in which way the process water will be treated, which is the quality of the water before and after treatment, quantity, composition and destination of waste water;
- the possibility for recycling process water.

The EIS must indicate in which way control and monitoring of the process will be handled, with special emphasis on:

- procedures for calamities, e.g. tailing dam failure, oil spill, fire explosions;
- monitoring of emissions to water and soil.

5.5.5 Rehabilitation

Rehabilitation should occur simultaneously with mining operations and after mining has ceased. Environmental recovery should be included as an integrated part of the overall mining plan. Recuperation can begin in a systematic manner at locations where mining has been completed, while mining continues elsewhere on the concession. The EIS has to provide an outline for the contents of such a rehabilitation plan.

Rehabilitation in order to provide favourable conditions for the regeneration of the natural vegetation should include:

- ! landscaping resulting in stable slopes, safe settling ponds and drainage of abandoned mines (no stagnant waters allowed);
- ! handling of forest debris, forest litter and top soil (removal during new mine developments and spreading over landscaped abandoned mines).

5.6 'No action' alternative and 'No action plus' alternative

5.6.1 **No action alternative**

The 'no action' alternative describes the situation that develops if the intended gold mining project will not be executed. This means that the small scale mining will continue (small groups of workers mining with none or limited mechanical means with all the consequent negative effects on the environment and the hampering to the socioeconomic development). The EIS must describe how and to what extent the objectives of the project can be achieved without the initiative of Margo Mining and how the region will develop in that case. The no action situation must be considered as a reference situation (see chapter 4).

5.6.2 **No action plus alternative**

The 'no action plus' alternative must describe the situation that arises when the initiative is not executed and improvement measures are taken for the small scale miners, e.g. through the distribution of mercury retorts.

5.7 Alternative most friendly to the environment

The alternative most friendly to the environment must be described in the EIS, taking into account that gold mining by nature has a negative effect on the environment.
It is a combination of the environmentally most favourable implementation and the environmentally most favourable management method, completed with the execution of all desired mitigation measures and the rehabilitation plan most favourable for nature and landscape.
This alternative must be compared with the other alternatives in chapter 7.

6. IMPACTS

6.1 General

The potential impacts must be described per alternative considered and must cover the complete affected area. This area may differ per aspect. Negative as well as positive impacts have to be described. Direct and induced impacts of the activity have to be described.

6.2 Impacts on the physical and natural environment

The EIS has to describe:

- ! impacts of the mining activities on the creek and river's environment:
  - increase in sediment load downstream from the mine due to clearance of vegetation, which increases erosion and due to disposal of mine material;

- changing of flow-patterns and in the erosion-sedimentation pattern;
- impacts on river and creek morphology, altering the original stream bed;
- impacts on fishery practices;
- impacts from stream siltation on flora and fauna (especially fish) and primary production (destruction of bottom habitat and turbidity);

! contamination of surface water and groundwater with potential adverse effects for land use, water quality (drinking water supply and water used for domestic activities) and aquatic ecosystems from mercury and speciation (natural or from tailings), mineral oils;
! increase in undesirable populations of bacteria, viruses and insects (malaria);
! impacts on natural vegetation and commercial, subsistence and endangered species;
! disruption to and modification of the topography of the area;
! impacts on the physical and natural environment by increasing population growth due to the improved employment situation (including possibility of new settlement areas and measurements to prevent further invasion of new settlers into vulnerable areas).

6.3 Impacts on the socioeconomic environment

The EIS must provide a description of:

! impacts on the health situation and basic living conditions (both in terms of an improvement due to new employment opportunities and use of safer methods for gold mining and in terms of possible negative impacts);
! effects on living conditions: pollution, risks (accidents, e.g. also due to reduced visibility for navigation purposes or danger of mud ponds), impact on local drinking water supply in relation to the mining activities, increase of mercury in fish;
! impacts on employment (direct and indirect) and income levels;
! effects of increased population pressure ('boom bust' economic, social or cultural conflicts, health risks);
! impacts on gender-relations;
! damage to cultural/historic sites.

7. COMPARISON OF ALTERNATIVES

Environmental effects of alternatives must be mutually compared. It is recommended to present the comparison in the form of tables and diagrams. In the comparison the current environmental situation, including expected autonomous developments ('no action' alternative), the 'no action plus' alternative and the alternative most friendly to the environment must be given.
The comparison must yield the preferred alternative.
Ideally the comparison of alternatives will yield tables. An example is given below:

alternatives criteria	no action	no action plus	alternative 1	alternative 2	preferred alternative	most friendly to environment
! geotechnical						
! environmental (including rehabilitation of the area)						

! socioeconomic						

8. GAPS IN KNOWLEDGE, MONITORING AND EVALUATION

In the EIS lacking information must be identified. The importance of this information for decision making must be evaluated. The EIS has to indicate in which way and through which means serious knowledge gaps can be filled in or alleviated.

In the EIS an environmental monitoring plan must be presented. This plan must include monitoring of:

- effectiveness of gold recovery;
- effectiveness of mitigation measures;
- impacts which are irreversible or unavoidable;
- water quality;
- levels of mercury and methylmercury in the muscle tissue of foodfish species at the end of the food chain (Instituut voor Visserijonderzoek, IJmuiden or Aquasense BV, Amsterdam);
- management and disposal of hazardous wastes;
- process and velocity of rehabilitation of the area;
- outbreak of malaria and venereal diseases;
- socioeconomic impacts.

The monitoring plan must indicate the institution(s) which are responsible for its implementation (e.g. GMD and local authorities) and the way implementation is funded. The monitoring plan must also include a description of where, how and when the sampling and monitoring should be conducted.

A project evaluation plan has to be included in the EIS, indicating which institution will be responsible for the evaluation. The main item of evaluation will be to which extent project objectives (improving resource management and the socioeconomic situation) have been fulfilled.

9. FORMAT AND PRESENTATION OF THE EIS

It is suggested that the EIS is written in the same format as this advice for Terms of Reference. The use of maps, tables and photo's may considerably increase comprehensiveness and is therefore recommended.

The EIS should be concise and emphasis must be laid upon significant environmental issues as mentioned in the 'main points of the advice'.

A nontechnical summary must be included in the EIS. This summary must address the major subjects of the EIS and be written in such diction that it provides non-technicians with a clear insight in the issues treated. This summary is important in the way that this will be the part of the document which will be read by most interested people.