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Environment, Forest and Climate change Commission

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT GUIDELINE FOR MINING SECTOR (FINAL REPORT)

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ADDIS ABABA, ETHIOPIA

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ABBREVIATIONS AND ACRONYMS

AMD	Acid Mine Drainage
ARD	Acid Rock Drainage
As	Arsenic
BOD	Biochemical Oxygen Demand
CO	Carbon monoxide
COD	Chemical Oxygen Demand
Cd	Cadmium
CBD	Convention on Biological Diversity
CBO	Community Based Organization
CRGE	Climate Resilient Green Economy
DO	Dissolved Oxygen
DRM	Disaster Risk Management
ECA	Environmental Competent agencies
EPE	Environmental Policy of Ethiopia
ESIA	Environmental Social Impact Assessment
EFCCC	Environment, Forest and Climate Change Commission
EBSAP	Ethiopia Biodiversity Strategy and Action Plan
ESMP	Environmental Social Management Plan
FDE	Fugitive Dust Emissions
GHG	Green House Gas
IESA	Initial Environmental Social Assessment
IFC	International Finance Cooperation
IAPs	International Association People and Environment
ICMM	International Council of Mining and Metal
Hg	Mercury
MoMP	Ministry of Mine and Petroleum
NOx	Nitrogen oxides
NGO	Non-Governmental Organization
pH	Potential Hydrogen-ions
PAG	Potentially Acid Generating
PPE	Personal Protective Equipment
PM	Particulate matter
Pb	Lead
RAP	Resettlement Action Plan
SO_2	Sulfur dioxide
TOR	Term of Reference
TSS	Total Suspended Solids
VOCs	Volatile Organic Compounds

GLOSSARY/TERMS USED IN THE GUIDELINE

Audit	A possible course of action that might be adopted in lieu of the proposal or activity or in terms of site, design, input, process, including the "no action" alternative. The process through which how well compliance with policy objectives and regulatory requirements is met and the fidelity of the implementation of conditions attached to an approved environmental impact assessment report is examined.
Adaptation	Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Adaptation benefits	The avoided damage costs or the accrued benefits following the adoption and implementation of adaptation measures.
Artisanal mining	A mining operation carried out by individuals or small and micro-enterprises which is mostly of manual nature and does not involve the engagement of employed workers
Baseline Information	A description of existing environmental, social and economic conditions at and surrounding project area.
Cause-effect Relationship	The connection between an action's disturbance (cause) and its effect on the environment.
Climate variability	Fluctuations in climate over a shorter term - the departures from long-term averages or trends, over seasons or a few years, such as those caused by the El Niño Southern Oscillation phenomenon.
Combined Effects	The effects caused by various components of the same action.
Climate change	A change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Climate scenario	A projection of future climatic conditions.
Competent Agency	Any federal or regional government organ entrusted by law with a responsibility related to Environmental Impact Assessment.
Cost-Benefit Analysis	Careful and explicit analyses of the costs and benefits of a proposed action. Such an analysis should also determine social discount rates for both costs and benefits.
Cumulative Impact	An impact that may in itself not be significant but the combination of one or more impacts that can have a greater effect than the sum of the individual impacts.
Environment	The physical, biological, social, economic, cultural, historical and political factors that surround human beings. It includes both the natural and built environments. It also includes human health and welfare.
Environmental Assessment	The methodology of identifying and evaluating in advance, any impact positive or negative, which results from the implementation of a proposed action.
Environmental Impact Assessment Report	A report containing sufficient information to enable the Environmental Agency to determine whether and under what conditions a proposed action should proceed.
Environmental Management Plan	An action plan that addresses the how, when, who, where and what of the environmental mitigation measure aimed at optimizing benefits and avoiding or mitigating adverse potential impacts of proposed operation or activity. It encompasses mitigation, monitoring, rehabilitation and contingency plans

Environmental Management System	Is the means of ensuring effective implementation of an environmental management plan or procedures and compliance with environmental policy objectives and targets.
Environmental policy of an organization	A statement by the organisation of its intentions and principles in relation to its overall environmental performance that provides a framework for action and for the setting of its environmental objectives and targets.
Environmental Protection Organs	Refers to the authority, the council, the sectoral and regional environmental agencies. Any change to the environment or its component that may affect human health or safety, biophysical conditions, or cultural heritage, other physical structure with positive or negative consequences.
Integrated Environmental and Development Management	A code of practice for ensuring that environmental considerations are fully integrated into all stages of the development process in order to achieve a desirable balance between conservation and development and promote environmentally sustainable use of resources.
Proponent/ Developer	Any organ of government, if in the public sector or any person if in the private sector that initiate a project or a public instrument.
Public instrument	Means a policy, a plan, a strategy, a program, a law or an international agreement.
Rehabilitation	Restoration of an environmental component, social service or system that has been affected by an activity to more or less its former states.
Regional Environmental agency	Any regional government organ entrusted by that Region, with a responsibility of the protection or regulation of the environment and natural resources.
Reviewing	The determination of whether or not the environmental impact study report meets the approved Terms of Reference and provides satisfactory information and analysis that is required for decision-making.
Scoping	The identification and "narrowing down" of potential major environmental impacts based on which a detail impact assessment will be conducted.
Screening	The process that decides whether or not a project requires assessment, and the level of assessment that may be required.
Interested and Affected Parties	Individuals or groups concerned with or affected by an activity and its consequences. These include local communities, work force, customers, or consumers, environmental interested groups and the general public.
Licensing agency	Any organ of government empowered by law to issue an investment permit, trade or operating license or work permit or register business organization as a case may be.
Mitigations	Measures taken to reduce or rectify undesirable impacts of a particular activity when an environmental evaluation process deems the impact is adversely significant.
Monitoring	The repetitive and continuing observations, measurements and evaluation of changes that relate to the proposed activity. It can helps to follow changes over a period of time to assess the efficiency of control measures.

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1. INTRODUCTION

1.1. Background

The mining industry can foster economic development by providing opportunities for decent employment, business development, increased fiscal revenues, and infrastructure linkages. Many of the minerals produced by mining are also essential building blocks to technologies, infrastructure, energy and agriculture. Ethiopia has diverse climate, landscape and geology. Due to this geological diversity, Ethiopia endowed with different types of mineral resources namely:

- Metallic minerals: Silver, lead, zinc, bromine, gold, platinum, niobium, tantalum, nickel, copper, chrome, manganese, and iron ore;
- Construction/ Industrial Minerals: Granite, marble, basalt, rhyolite, scoria, limestone, sandstone, clay, silica sand, pumice, quartz, coal, gypsum, bentonite, perlite, diatomite, potash, and halite;
- Gemstones: Emerald, sapphire, opal, jasper, olivine, peridotite, topaz, corundum and
- Fossil fuels: Petroleum and Natural gas.

Mineral resources in Ethiopia are mined by state-owned corporations, private companies and artisanal and small-scale miners. Mining project licenses vary according to the scale of the project development and type of ores or materials to be extracted from the earth. According to the mining operation proclamation, mineral development permits has classified into three license ranks:

- Prospecting license (ESIA not required),
- Exploration license, and
- Mining (exploitation) license.

Mining (exploitation) license is further divided into:

- Artisanal mining;
- Special small scale mining;
- Small scale mining; and
- Large scale mining.

1.2. Mining and Environmental Challenges

Historically, mining has contributed to many of the challenges like environmental degradation, ecosystem disruption, displacement of populations, worsening of economic and social inequality, conflicts, gender-based violence, tax evasion and corruption, increased risk for many health problems, and the violation of human rights (Mining SDG, 2016). Additionally, climate change is also a critical issue and mining companies both contribute to and are affected by climate change. Therefore, a sustainable mineral development can be achieved only through taking into consideration social, economic, climate change and environmental situations in mining development work through Environmental and Social Impact Assessment (ESIA) implementation.

One of the major environmental challenges facing Ethiopia is global climate change and increased climate variability that affects many aspects of citizen life and economy: human settlements, agriculture, water availability, health, tourism and the frequency and severity of disasters from floods and droughts (CRGE, 2011). The importance of the Environmental Impact Assessment (ESIA) was identified as an effective instrument for environmental and socioeconomic impacts management of any developmental activities. In relation to this, there should be well-designed ESIA guideline to conduct an effective environmental and social impact assessment. However, under the existing mining ESIA guideline, the impacts of climate change, socio-economic, disaster risk, and detail ecological value services on the sustainability of mineral development and construction or other long-term infrastructure projects are not addressed. Therefore, this mining ESIA guideline is developed within the context of emphasizing the impacts related to social issues, climate change, ecosystem services and disaster risk management.

1.3. Objectives of the Guideline

The main objective of this guideline is to assist environmental competent agencies in making decisions and approval of proposed mining and petroleum projects in the framework of ESIA process. In addition, it supports project proponents, ESIA practitioners, affected communities and other stakeholders to understand and follow the ESIA process and the basis on which decisions on ESIA applications are made. This will facilitate greater consideration and integration of environmental concerns in mining development projects, policies, plans and programs in Ethiopia.

1.4. Scope of the guideline

This ESIA Guideline is applicable to all range of mining projects in Ethiopia including artisanal mining, which has also significant environmental impacts, but exempted by mining operation proclamation no. 678/2010.

2. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) PROCESSES

The purpose of an environmental and social impact assessment (ESIA) is to ensure that the development options under consideration are environmentally sound and sustainable, and any environmental consequences are recognized early in the project cycle and taken into account in project design. ESIAs identify ways of improving projects from environmental point of view, and minimizing, mitigating, or compensating for adverse impacts. The process also provides a formal mechanism for inter-agency coordination and for addressing concerns of affected groups and local non-governmental organizations (NGOs).

The ESIA process evaluates a project's potential environmental risks and impacts in its area of influence; identifies and evaluates potential impacts from climate change on the project's area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and anticipated adverse impacts from climate change, and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts and anticipated adverse impacts from climate change throughout project implementation. In addressing anticipated adverse impacts from climate change, the implementation of appropriate adaptation planning and management mechanisms is favored. ESIA process has different phases which are discussed in subsequent sections.

2.1.Project Identification

At this stage of the processes, the proponent expected to identify the nature of the project's impacts on environmental and socioeconomic to inform ESIA screening and scoping.

2.2. Screening

Screening is an initial phase in the ESIA process. It is conducted to determine whether full ESIA or initial environmental and social assessment (IESA) is required or not for particular mining development activity. This depends on the significance of mining projects on environmental and social impacts. The significance of mining projects depends on: the sensitivity of the mining area likely to be affected; ecosystem services, climate- sensitive issues; health and safety; the possibility

of uncertain, unique or unknown risks; the possibility of having significant impacts; whether the proposed activity affects protected areas, endangered or threatened species and habitats; and size, working methods, project activities including their duration and proposals for waste disposal.

Based on the impact level, categorization of the outcome of screening could be one of the following:

- No ESIA is required;
- Initial environmental and social assessment is needed;

  This applied to:
  - Projects with limited impacts,
  - Projects in which the need of ESIA is unclear, and
  - Proposals with inadequate information.
- Full scale ESIA is mandatory – this applies when there is sufficient ground and significant impacts identified for detail assessment.

2.3. Scoping

Scoping is a procedure used to determine the range of issues to be addressed in the ESIA study. It is the process of identifying the significant issues, which are related to the proposed project. The main objective is to focus on the ESIA on the key issues, while ensuring that indirect and secondary effects are not overlooked and eliminating irrelevant impacts. Thus, scoping identifies the key concerns, evaluates them, organizes and presents them to aid decision-making. Like in screening phase, scoping pivots on the issue of significance. The Terms of Reference (TOR) for an ESIA study are formulated during scoping phase.

ESIA scoping process should include the following aspects:

- Project description and definition of spatial boundaries - the definition of the project and its area of influence;
- Definition of other project boundaries - the identification of temporal boundaries affecting project activities (including time frame for climate change impacts that are to be evaluated), and the identification of regulatory, administrative and customary aspects affecting the project or project activities.

- Baseline environmental setting - data to be collected and monitored for the identification of ecological, climatic, cultural and social features relevant to the spatial and temporal boundaries of project activities;
- Project-relevant climate models - the identification of appropriate climate predictions relevant to the -spatial and temporal boundaries of project activities;
- Mining project relevant climate change and disaster risk scenarios - analysis of project relevant "downscaled/area specific" climate change and disaster risk scenarios, valuing of ecosystem services of the mining project area.

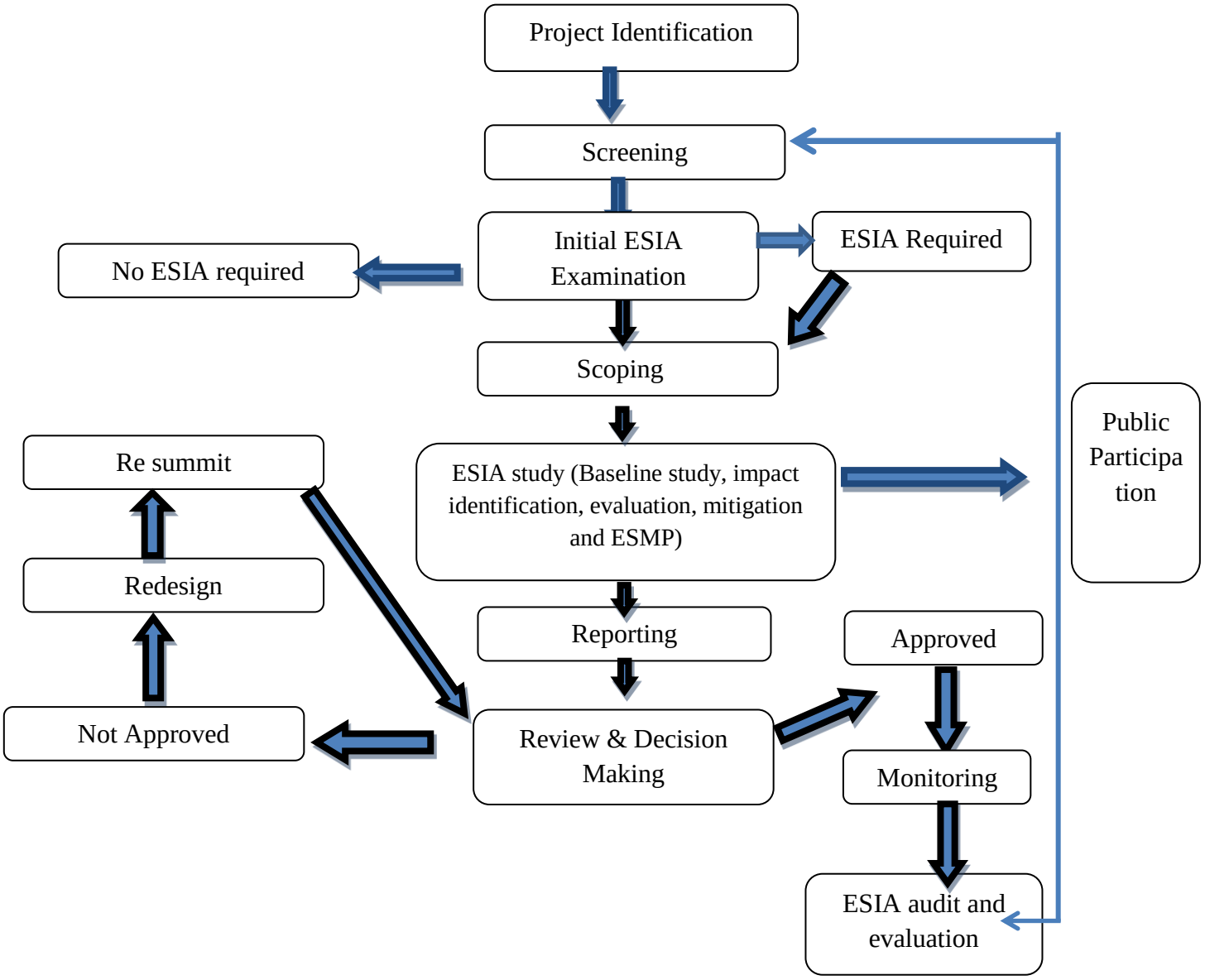

Figure 1: Summarized stages of ESIA processes

2.4. ESIA Study

Environmental and social impact assessment study is the process of identifying, analyzing, predicting, and evaluating the potential environmental impacts that would result from the exploration, development, operation and decommissioning of the proposed project. It will be conducted by an independent consultant for the project proponent in accordance with the Terms of Reference and/ or the range of issues identified during the scoping process.

Key tasks implemented during ESIA study are:

- Baseline data collection,
- Impact identification,
- Impact prediction,
- Impact analysis,
- Consideration/redesign of alternatives,
- Preparation of management plan,
- Preparation of monitoring strategy/plan,
- Closure plan,
- Public consultation, and
- Preparation of ESIA report,
- Assessing impacts characteristics should be carried out with well-defined values of significance,
- Compare all feasible alternatives,
- Document the values and beliefs on which judgments are based, and
- Based on acceptable methodology, research and experimental findings.

Impact significance criteria include:

- Climate change sensitive,
- Ecological importance,
- Effect of public health/risks to life,
- Biodiversity and ecosystem services,
- Socio-economic importance,
- Environmental standards,

- Experimental findings,
- Statistical significance, etc.

Impact Mitigation Measures try to find:

- Better ways of doing things,
- Minimize or eliminate negative impacts,
- Enhance benefits,
- Protect public and individual rights to compensation,
- Alternative ways of meeting the needs,
- Changes in planning and design,
- Improving monitoring and management,
- Monetary compensations,
- Performance bond, and
- Replacing, relocating, rehabilitating.

Impact management plan should:

- State policy and standards,
- Indicate environmental effects, the issue and activity required to address it,
- Define responsibilities and provide a schedule of tasks,
- Include a system of reporting,
- Include a system for monitoring,
- Indicate resources required for completion with relevant actual costs, including training and equipment needs,
- Describe the proposed mitigation measures,
- Contain a contingency plan, etc.

2.5. Environmental and Social Impact Assessment (ESIA) Report

The ESIA report should be concise to significant environmental and socioeconomic impact issues. The main text should focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. It should also focus in accordance with the Terms of Reference and/ or the range of issues identified during the scoping process. Environmental and social impact assessment report mainly organized according to the outlined under Annex I.

2.6. ESIA Report Review

Review of ESIA report submitted to the competent environmental agencies to examine and determine whether the ESIA-report is adequate information of the environmental and socioeconomic impacts for decision-making. Based on the outcome of the review, competent environmental agencies will accept, reject or make further modifications to ensure project sustainability.

2.7. ESIA Implementation Follow-up

Follow-up is continuous observations, measurements and evaluation of changes that relate to the proposed project activities. It can help to follow-up changes over a period of time, to assess the efficiency of mitigation measures and to capture unforeseen environmental impacts of the project. This is very essential part of the project implementation. Some impacts may need continuous monitoring during the construction and operation phases of the project. ESIA follow up is conducted by project proponent, environmental regulators, local administration, affected community and other concerned stakeholders.

3. POLICIES AND LEGAL FRAMEWORKS

This section describes the national and international policies and laws relevant to the implementation of mining projects. Several policies, proclamations, and guidelines have been put in place to cater for environmental and social compliance by mineral development projects. All policies, proclamations and guidelines explained in this section should describe their relations with the mining project activities.

3.1. National Policies

3.1.1. The Federal Democratic Republic of Ethiopia Constitution

The constitution is the supreme law of the country, where provisions, regulations, institutional framework must comply with. In the Ethiopian constitution, there are direct and indirect articles stated supporting environment-related issues for the sustainable development program. The following articles are also mentioned in the constitution.

Article 43: Indicate the right to development and fundamental rights and freedoms. According to this article peoples' have right to:

- Improve living standards and to sustainable development,
- Participate in national development, particularly in consultation with respect to policies and projects affecting their community, and
- Enhance their capacities for development and to meet their basic needs.

Article 44

Indicates that "all persons have the right to live in a clean and healthy environment".

Article 92

Indicates that:

- "Government shall endeavour to ensure that all Ethiopians live in a clean and healthy environment."
- "The design and implementation of programmers and projects of development shall not damage or destroy the environment."
- "People have the right to full consultation and to the expression of views in the planning and implementation of policies and projects that affect them directly. "

- "Government and citizens shall have the duty to protect the environment. "

3.1.2. Environnemental Policy

The Environmental Policy of Ethiopia (EPE) was issued in April 1997. The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians and promote sustainable social and economic development through sound management and use of natural, manmade and cultural resources and their environment as a whole, so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. The policy addressed mineral resources as one of the sectoral environmental policy issues (Section 3.6) and environmental and social impact assessment (ESIA) as a cross-sectoral environmental policy (Section 4.9). In Section 3.6a (mineral resources), the policy acknowledges that mineral resources are not renewable resources. The policy consists mainly of guiding principles and various sectoral and cross-sectoral policies for sustainable environmental management.

The policy seeks to ensure the empowerment and participation of the people and their organizations at all levels in environmental management activities, raise public awareness and promote understanding of the essential linkage between environment and development. In addition to its guiding principles, the policy addresses sectoral and cross-sectoral environmental issues.

3.1.3. Draft Mineral Resource Development Policy

The Ethiopia mineral resource development policy was drafted in 2019 and addressed the pillars and priorities areas with the intention of ensuring a system that guarantees minimum damage on the environment in the process of mining activities by using the best technology and putting in place mitigation strategies consistent with sustainable development goals.

The general instruments of policy implementation include:

- Promoting and ensuring a mineral sector development that is consistent with goals of sustainable development,
- Putting in place fiscal and other instruments that strike a balance between attracting quality investment in the sector and sustainable social benefits,
- Cultivating and ensuring efficient mineral administration and
- Planning and strategizing mineral sector development in the country.

3.1.4. Draft Petroleum Operations Policy

One of the key focus areas of the policy is article 2.4 that targeted to ensure the survival of human beings and all other forms of life while guaranteeing sustainable development, environmental protection and development endeavors should be balanced by applying internationally accepted procedures.

In the policy document, one can find the following key strategies:

- Licensees shall submit environmental and social impact assessments, environmental management plans, impact mitigation measures, emergency preparedness response plans, decommissioning and restoration plans to the regulator. They shall also incorporate the measures they have taken in their annual reports;
- Key principles of environmental law such as the precautionary principle, the polluter pays principle, and strict liability shall be applied;
- To ensure that licensees have discharged their obligations regarding mitigation measures on long and short-term environmental impacts, a guarantee provision system shall be established;
- While conducting petroleum operations in the water-ways used by the people or domestic or wild animals, licensees shall use internationally recognized best available technologies to avoid or minimize injuries that could happen;
- Petroleum operations' waste disposal system, materials quality measurements, radiation and energy application and technical related issues shall follow the national and international legal rules and best practices;
- Licenses shall participate in community development activities within their petroleum operation area and allocate annual budget till their operation is completed;
- A system shall be established to encourage the utilization of vehicles and machinery which have low environmental impacts.

3.1.5. Disaster Risk Management (DRM) Policy

The Government of Ethiopia has endorsed a comprehensive DRM policy based on lessons learned from previous experience. These include: the necessity of a multi-hazard approach grounded in a deep understanding of specific disaster risk and its link to development and vulnerability; emphasis on prevention, mitigation, preparedness, and post-disaster modalities and capacities; de-centralization of resources and structures; a precise determination of DRM responsibilities supported by the ability for legal enforcement and a high degree of accountability.

The new DRM policy provides direction for the kind of DRM system envisaged for Ethiopia in the future. Such system is based on an enabling policy environment and strategy. It relies on organizational structures with appropriate and harmonized roles and responsibilities at federal, regional, and woreda levels. Horizontal and vertical coordination among decision-making bodies and effective DRM systems, processes, and procedures is ensured.

Furthermore, the system is based on an understanding of disaster risks; on practical and targeted information flows for decision making and community DRM; on resources preparedness, ensuring appropriate and timely availability of key resources; on adequate implementation capacity, including resource delivery; and on mechanisms for learning lessons and feeding into planning and decision-making.

3.1.6. Water Resource Management Policy

The former Ministry of Water Resource prepared the water resources management policy of Ethiopia. The overall goal of the policy is to enable and promote all national efforts towards the efficient, equitable and optimum utilization of the available water resources of Ethiopia for significant socio-economic development on a sustainable basis. The policy ensures water allocation for water supply and sanitation as the highest priority while apportioning the rest for uses for socio-economic benefits. The policy also recognized the allocation of water for livestock as well as for environment reserve is also regarded as a priority area in any water allocation.

3.1.7. Health Policy

The health policy under Article 3.4 stipulates the need to develop safe disposal of household, camps and industrial wastes, and encourages the recycling of waste. This policy under Article 5.3 also indicates the need to prevent environmental pollution from hazardous chemical wastes.

Public health proclamation No. 200/2000 was promulgated by the Federal Republic of Ethiopia on 9th March 2000. The proclamation is meant to promote the participation of the society in the health sector and enforce the objectives of the health policy of Ethiopia. The proclamation under its Part II discusses public health issues, including; food quality control, water quality control, and waste handling and disposal, availability of toilet facilities, control of bathing places and pools, etc. The article which deals with waste handling and disposal further elaborates that:

- Any person shall collect waste in a specially designated place and in a manner that does not affect the health of the society and no person shall dispose solid, liquid or another waste in a manner that contaminates the environment or affects the health of the society.
- Any solid, liquid and other wastes generated from hospitals should be handled with special care and their disposal procedures should meet the standards set by the public health authorities.

3.1.8. Women's Policy

Apart from being a signatory of major conventions that protects women from discrimination and others, the Ethiopian Government has also expressed its commitment to gender equity and equality by issuing a national policy on Ethiopian women.

The policy, which was issued in 1993, has the following objectives:

- Facilitating conditions conductive to the speeding of equality between men and women so that women can participate in the political, social and economic life of their country on equal terms with men and ensuring that their right to own property as well as their other human rights are respected and that they are not excluded from the enjoyment of their fruits of their labor or from performing public functions and being decision-makers;
- Facilitating the necessary conditions whereby rural women can have access to basic social services and to ways and means of lightening their work load; and

- Eliminating step by step, prejudices as well as customary and other practices that are based on the idea of male supremacy and enabling women to hold public office and to participate in the decision making process at all levels.

3.2. Legal Frameworks

3.2.1. Establishment of Environmental Protection Organs (Proc. No.295/2002)

This Proclamation has stipulated the need to establish a system that enables to foster coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels. The Proclamation has also required the establishment of sectoral and regional environmental units and agencies, respectively. This shows that institutionalizing and mainstreaming environmental concerns has a legal basis.

3.2.2. Environmental Impact Assessment Proclamation (Pro. No. 299/2002)

This Proclamation (No 299/2002) aims primarily at making the ESIA mandatory for categories of projects specified under a directive issued by the EFCCC. The law specifies the projects and activities that will require an environmental and social impact assessment (ESIA). The proponent of the project must prepare the ESIA following the format specified in the legislation. The EFCCC will then review the ESIA and either approve the project (with or without conditions) or reject it. The Proclamation requires the following among the other things:

- Specified categories of projects to be subjected to an ESIA and receive an authorization from the environmental competent agencies prior to commencing implementation of the project;
- Licensing agencies to ensure that the requisite authorization has been duly received prior to issuing an investment permit, a trade or operating license or a work permit to a business organization;
- The EFCCC or the relevant regional environmental agencies may issue an exemption from carrying out an ESIA in projects supposed to have an insignificant environmental impact; and
- A licensing agency may suspend or cancel a license that has already been issued where the EFCCC or the relevant regional environmental agency suspends or cancels environmental authorization.

To put this Proclamation into effect, the EFCCC issued guideline documents which provide details of the ESIA process and its requirements.

3.2.3. Environmental Pollution Control Proclamation (Pro. No. 300/2002)

Proclamation no. 300/2002 on environmental pollution control primarily aims to ensure the right of citizens to a healthy environment and to impose obligations to protect the environment. The proclamation is based on the principle that each citizen has the right to have a healthy environment, as well as the obligation to protect the environment. The law addresses the management of hazardous waste, municipal waste, the establishment of environmental quality standards for air, water and soil; and monitoring of pollution. The proclamation also addresses noise and vibration as one source of environmental pollution and it seeks for standards and limits for it providing for the maximum allowable noise level taking into account the settlement patterns. In general, the Proclamation provides a basis from which the relevant environmental standards applicable to Ethiopia can be developed, while sanctioning violation of these standards as criminally punishable offences.

Furthermore, it empowers the Federal EFCCC and/or the Regional Environmental Authority to assign environmental inspectors with the duties and responsibilities of controlling environmental pollution. In order to ensure the implementation of environmental standards and related requirements, inspectors belonging to the EFCCC or the relevant regional environmental agency are empowered by the Proclamation to enter without prior notice or court order. Such wide powers derive from Ethiopia's serious concern and commitment to protect the environment from pollution.

3.2.4. Hazardous Waste Management Proclamation (Pro. No. 1090/2018)

Article 6 states that hazardous waste generator shall have the have the following responsibilities:

- Collect, segregate and dispose or case to be collected, recycled or disposed of hazardous waste by authorized body;
- Ensure that the container of hazardous waste are properly packed and conspicuously labeled with Amharic and English language ;
- Keep record on the type and quantity of hazardous waste that exist at the temporary hazardous waste storage facility and show the record at any time when requested by inspector; and

- Not to store any hazardous waste at a temporary storage facility for a period exceeding one month.

3.2.5. Mining Operations Proclamation (Proc. No. 678/2010)

The mining proclamation which was issued in 2010 to promote sustainable mining development is mining operations Proclamation No. 678/2010 (as amended) that addressed the environmental issues very well. Sustainable development issue is applicable to the mining activity as well as the environmental aspect of the operation. This proclamation is amended by Proclamation No. 816/2013.

The more relevant articles to this guideline under this Proclamation are article 59, 60, 61 (compensation issues), article 62 (Environmental Impact Assessment and Rehabilitation Fund); article 63 (Mine Closure); and article 64 (Remedial Powers of the Licensing Authority).

3.2.6. Proclamation on Expropriation of Landholdings for Public Purposes (Proc. No 1161/2019)

The objective of this proclamation was to define the basic principles that have to be taken into consideration in determining compensation to a person whose landholding has been expropriated. The proclamation has established detail procedures setting the time limits within which land could be acquired after a request is received from a proponent, principles for assessment of compensation for properties on the land as well as for displacement compensation. The proclamation also empowered the woreda administration to establish evaluation committee to value private prosperities. Additionally, the proclamation provided for appeals on the valuation decisions but such action would not delay the transfer of possession on land to the proposed development activities.

The proclamation has also removed the barriers to planned land acquisition, substantially raised the amount of compensation payable to expropriated owners of properties and displaced people. In addition to financial compensation in an amount sufficient to reinstate the displaced people to the economic position prior to displacement, the relevant local administration is required to give replacement land to any person who has lost land in favor of a public project. An assessment of compensation does not include the value of the land itself since land is public property not subject to sale in Ethiopia.

3.2.7. Labour Proclamation No. 1156/2019

This proclamation states that any employer has the obligation to take the necessary measure to safeguard adequately the health and safety of the workers. Moreover, it states that the employer in particular should take appropriate steps to ensure that workers are properly instructed and notified concerning the hazards of their respective occupations and the precautions necessary to avoid accident and injury to health; ensure that directives are given and also assign safety officer; establish an occupational, safety and health committee, provide workers with protective equipment, clothing and other materials and instruct them of its use; register employment accident and occupational diseases; ensure that the work place and premises do not cause danger to the health and safety of the workers; take appropriate pre-executions to ensure that all the processes of work shall not be a source or cause of physical, chemical, biological, ergonomical and psychological hazards to the health and safety of the workers.

3.2.8. Climate Résilient Green Economy Strategy

To cope with the prevailing environmental problems such as land degradation and climatic hazards (rainfall fluctuation, increasing temperature, flooding), and speed up its socio-economic development, the government of Ethiopia has planned a climate-resilient green economy as a development strategy. This development direction promotes environmental protection, reducing fossil fuel consumption which releases greenhouse gases into the atmosphere. With the growing demand for energy with the increasing population, industrialization and urbanization, the government realized that harnessing clean and renewable energy sources such as wind, solar, hydro and geothermal energy sources was critical. It has indicated that these natural resources would deliver electricity at virtually zero GHG emissions. The generated electricity is a fundamental enabler of modern economic development from powering cities and fuelling industrial activity to pumping water for irrigation purposes in agriculture. The government also decided to increase its income through exporting electric power generated from clean sources to neighbouring countries.

3.2.9. National Biodiversity Strategy and Action Plan

Ethiopia has prepared the national biodiversity strategy and action plan as of December 2005. The current Ethiopian biodiversity strategy and action plan (EBSAP) will address interlinked issues comprising biodiversity protection and management for food security (poverty reduction), health and livelihood improvement of the Ethiopian population, especially the rural communities

(farmers and pastoralists) whose survival depends on the use of natural resources. In parallel, it is the first attempt to meet the planning requirements of the convention as well as the national biodiversity conservation needs. It tries to roll into one of the three sequential processes called for under the convention (the country study, national strategy, and action plan). As such, it provides a brief assessment of the status and trend of the nation's biodiversity, outlines strategic goals and objectives, and identifies a plan of action that outlines co-ordination arrangements and implementation measures.

The goal of the Ethiopian Biodiversity Strategy and Action Plan has been formulated as "*Effective systems are established that ensure the conservation and sustainable use of Ethiopia's biodiversity, that provide for the equitable sharing of the costs and benefits arising therefrom, and that contribute to the well-being and security of the nation.*"

Ethiopia's biodiversity conservation priorities are found in the four strategic objectives:

i. Representative examples of Ethiopia's remaining ecosystems are conserved through a network of effectively managed protected areas;
ii. By 2020, all remaining natural ecosystems outside of the protected areas are under sustainable use management;
iii. The costs and benefits of biodiversity conservation are equitably shared through a range of public, private, community/CBO and NGO partnerships for PA management and for sustainable use and marketing of biodiversity; and
iv. The rich agro-biodiversity of Ethiopia is effectively conserved through a mix of in situ and ex situ programs.

The strategic objectives are then followed by a much longer list of specific objectives. Each specific objective will be achieved through a set of individual actions. A timeframe and performance indicator is defined for each action and institutional responsibilities are proposed.

3.3. International Conventions

Ethiopia has ratified different international conventions on natural resources and environmental management.

The principles of the 1972 Stockholm Declaration, the rationale underlying ESIA can be identified in Principle 14, which states: *rational planning constitutes is an essential tool for reconciling development and environment needs*. In the same spirit, principle 15 states as ‘’*planning must be applied to human settlements and urbanization with a view to avoiding adverse effects on the environment and opting maximum social, economic and environmental benefits for all’’.*

The 1992 Convention on Biological Diversity (CBD) requires parties to identify categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, to monitor their effects through sampling and other techniques and to require ESIA of proposed projects that are likely to have significant adverse effects on biological diversity

The 2000 protocol on biosafety to the convention requires risk assessments to be carried out in respect to important decisions relating to living modified organisms, in order to identify and evaluate the possible adverse effects of such organisms on the conservation and sustainable use of biological diversity, taking also into account risks to human health. The Federal environment, forest and climate change commission is designated as the focal point for the implementation of the above conventions.

4. ROLES AND RESPONSIBILITIES OF STAKEHOLDERS

4.1. Federal Environment, Forest and Climate Change Commission/EFCCC/

An environmental authority is either EFCCC or regional environmental body that is mandated by a proclamation provided for the establishment of environmental protection organs (proc. no.295/2002) and environmental impact assessment proclamation (proc.no.299/2002) and other relevant laws to oversee and facilitate the implementation or administration of ESIA**.**

In general, an EFCCC has to check the following responsibilities:

- The necessary system that contains procedural and technical guidelines is prepared and implemented,
- The public, especially affected communities are given a meaningful opportunity in the EA process,
- Views concerns and position of IAPs are taken into account during the assessment, reviewing, auditing and at all stages of decision making,
- Identify whether all processes in EA administration is made in a transparent, participatory and accountable manner,
- The proponent's right to appeal and understanding of the process is respected at all times,
- Incentives structures are prepared to incite and encourage environmental-friendly practices,
- EA audits are conducted at various stages in the EA process and at the corresponding levels in the project cycle and a step wise approval is done,
- Liaison with relevant licensing agencies is maintained,
- Activities' schedules are continuously updated,
- Appeals and grievance are entertained and decisions are communicated in good time,
- Proponents are provided with advice that help them best comply with the EA requirements,
- Decisions are made without unnecessary delay and within the time frame stipulated in the relevant laws and in a manner that improves effectiveness and efficiency, Appropriate support is made available to build capacity and create awareness on EA, etc.

4.2. Regional Environmental Agencies

In the environmental impact assessment process, the regional environmental agencies or their equivalent competent authority are responsible to:

- Adopt and interpret federal level EA policies and systems or requirements in line with their respective local conditions,
- Establish a system for EA of public and private projects, as well as social and economic development policies, strategies, laws, or programs of regional level functions;
- Inform EPA about malpractices that affect the sustainability of the environment regarding EA and cooperate with EPA in compliant investigations,
- Administer, oversee, and pass major decisions regarding impact assessment of:
    - Project subjected to licensing by regional agency,
    - Project subjected to execution by a regional agency, and
    - Project likely to have regional impacts.

Regarding projects and activities under the jurisdictions of federal EPA, regional agencies should write an endorsement letter verifying or confirming that:

- The biophysical and socio-economic baseline conditions are adequately and truly described,
- During scoping major issues are well defined and explicitly indicated in the Term of Reference (TOR),
- Interested and especially the affected parties or their true representatives are provided with all means and facilities (e.g. notice, assembly holes, reasonable time, understandable language) that enable them to adequately air their views and concerns,
- IAPs have agreed to and satisfied with the terms of compensations and the appropriateness of the EMP,
- The environmental monitoring activities are undertaken in the appropriate time with the involvement of the IAPs and regular reporting is made in good faith and time to all concerned bodies,
- The proponent/consultant fulfill the local and regional legal and policy requirements and obtain the necessary permits,
- The envisaged benefits to that communities and the regions are tangible,

- The monitoring plan is logical and allows the participation of relevant bodies in the region,
- The strategy for impact communication and reporting was understandable and appropriate at regional level stakeholders,
- The minutes of the consultation process reflects the true and unbiased accounts of the opinions and interests of the IAPs at the local level,
- Establish the necessary condition for the creation of awareness on EA, and
- Develop the necessary incentive and disincentive system, etc.

4.3. Proponent

A proponent is any person that initiates a project, policy or program, that is, if in the public sector an organ of government, and the private sector an investor.

A proponent is required to:

- Proactively integrate environmental concerns into its social and economic development project, program, policy, plan or strategic initiative as per the requirements of relevant environmental laws and directives,
- Ensure that positive effects are optimized and strive to promote conservation-based development and work with objectives of continuous improvement,
- Initiate the EA process and create the necessary ground for undertaking EA,
- Appoint an eligible independent consulting firm who shall seek to undertake EA ,
- Cover all expenses associated with the environmental and social impact assessment. This may include the costs of:
    - Undertaking the EA,
    - Public participation process,
    - Reviewing ESIA report as the need arise,
    - Preparation and implementation of EMP, that include both mitigation and monitoring measures and the associated institutional and human resources,
    - Closure plan as the case may be,
    - Environmental Management System,
    - Contingency plan, and
    - Reporting, environmental education, etc.
- Submit to EPA or the relevant regional environmental agency an ESIA report together

with the necessary documents requested both in electronic and hard copies,

- Observe the terms and conditions of authorization and work in partnership and cooperation with all responsible and interested parties,
- Provide the necessary reports for stepwise decisions required for approval of the proposal,
- Involve all interested and affected parties, and to that effect take all reasonable and practical measures to notify the latter in good time,
- Establish environmental units to monitor the environmental performance of the project in a proactive manner to ensure sustainable development,
- Consult relevant government institutions as the case may be,
- Report on regular bases about its environmental performance,
- Establish database and network with all concerned parties, and respect local values and interests,
- Develop standardize environmental management system, and
- Be familiar with the pertinent EA related stipulations, etc.

4.4. Consulting Firm

A consulting firm is an institution that can command the required qualified professional working group that has demonstrated the ability to undertake the EA and meets the requirements specified under the relevant law.

The firm that will be appointed to work on behalf of a proponent is expected to:

- Have the expertise in environmental impact assessment and management commensurate with the nature of the proposed activity and legal requirements,
- Make available an interdisciplinary team, having solid technical skills and legal and local knowledge,
- Manage the participation of interested and affected parties in an acceptable manner,
- Have the facility to produce readable reports that are thorough and informative,
- Declare and ensure at all times that has no vested interest in the proposed activity and observe all ethical values of the calling,
- Familiar itself with legal and technical requirements of all the concerned bodies, and be able

to include :

- Statements from the regional environmental agencies,
- Certificates and recommendations from the sectoral agencies,
- Statements of local administration approval as the case maybe, and
- Endorsed minutes of the public consultation process by appropriate local authority, as the verification of the truthfulness of all information contained in the ESIA- report as well as the fairness of the process.

- Provide additional detailed information related to the environmental impact study report as may be requested,
- Ensure that interested and affected parties are provided with all means and facilities (e.g. notice, assembly holes, reasonable time, understandable language, fair representation, etc.) enabling them to adequately air their views and concerns,
- Fulfill that they are legally registered and licensed to conduct the task,
- Capable of presenting an authentic complete CV of experts to be employed for the task,
- Present a true, pragmatic, analytical, understandable, and impartial account of the proposed activity, etc.

4.5. Interested and Affected Parties

Interested and affected parties are individuals or groups concerned with or affected by the proposed activity or its consequences. These may include local communities, the work force, customers and consumers, environmental interested groups and the general public.

Interested and affected parties are expected to:

- Provide comments at various stages of EA with a reasonable time-frame,
- Work in partnership with environmental agencies and proponents,
- Act and lobby in good faith, knowledge, reason and in a cooperative manner and use all means and facilities to ensure fairness in EA administration,
- Follow and monitor changes and inform the environmental and sectoral agencies and local administration the occurrence of adverse incidence or any other grievance in the course of implementation of a project or public instruments,
- Advocate and uphold the principle and values of environmentally sustainable development, etc.

4.6. Licensing Agency

Licensing Agency is any organ of government empowered by law to issue an investment permit, trade or operating license or work permit or register business organization as a case may be.

Licensing agencies are required to:

- Ensure that prior to issuing their respective licenses and permits, have legal duty to require proponents to submit authorization, a letter of approval or environmental clearance certificate awarded by the appropriate environmental agency,
- Ensure that environmental performance criteria are included in their respective sectoral incentive or disincentive structure,
- Ensure that renewal or additional permits issuance should also considers integration of environmental concerns, and
- To seek advice or opinion from the appropriate environmental agency, etc.

4.7. Public and Stakeholder Consultation

The public consultation during ESIA should identify and list the known interested and potentially affected parties by project activity and concerned stakeholders. This may be done in consultation and collaboration with the relevant authorities in the project area in the following aspects:

- Public and stakeholders consultation on positive and adverse impacts of the project,
- Locally available indigenous knowledge's for project adverse impact mitigation and their level of participation,
- Dissemination of project information to all the affected communities and interested parties, updating them about the project made and eliciting their views on the project,
- To establish environmental issues of public concern,
- Apart from being directly involved in the actual ESIA study,
- The public should be involved in every part of ESIA including review of the ESIA, and
- Information obtained from public and stakeholders consultations should be documented in the ESIA report.

The detail approaches and procedures concerning public and stakeholder consultations can be obtained from "Public Consultation Guideline in ESIA Process" (EFCCC, 2018).

5. PROJECT DESCRIPTION AND ALTERNATIVES

5.1. Project Description

Detail description of the project activities include: overall project cost, designs, processes, inputs, outputs, maps, mining procedures, time schedules, transpiration means and management, physical assets and respective designed location, facilities and infrastructures, waste treatment plants, power and machinery installation.

The project description should address the following activities under exploration, mine development, decommissioning and closure phases. The proposed major surface infrastructure required for the mine should be described briefly and shown on a topographical map. This should include:

- Roads, railways, power lines and access routes to and within the plant,
- Mining methods
- Solid waste management facilities,
- Industrial and domestic waste disposal sites,
- Mine residue disposal sites. Give or show on the plan the type of residue, final extent of the dumps, construction method and water reticulation layout,
- Water pollution management facilities,
- Sewage plant location, its design capacity and the process to be used,
- Pollution control dams, paddocks and evaporation dams. Indicate if these are to be lined or not,
- Water treatment facility, its design capacity and treatment method,
- Water supply system, its location and design capacity
- Mineral processing plant,
- Workshops, administration and other buildings,
- Housing, recreation and other employee facilities,
- A brief description of the activities during construction period is required, including a plan if necessary,
- Direct employment during construction possible influx of labours and stress on public utilities and services,

- Use of water and power and its source during construction, proposed earth moving, dredging and drilling operations,
- Proposed plan for transportation and storage of construction material,
- Detailed schedule of activity and resource requirements, and
- Disposal of solid waste/dredged material.
- The proposed mine surface layout (plan required) - this section requires a brief, illustrated description of the items below using the site plan as a base map for all mines:
    - Access to the workings (vertical and incline shaft positions or adits, ramps and haul roads),
    - All structures that may be affected by blasting vibrations,
    - Anticipated location, extent and depth of surface subsidence,
    - All structures and drainage paths that may be affected by surface subsidence,
    - The mining plan, box cut and final void positions,
    - Mineral processing. A brief description of the mineral processing method is required. This description should highlight areas in the plant that could generate air, water and noise pollution,
    - Plant residue disposal,
    - A brief description of the disposal method(s) giving tons disposed per day at full production for each type of residue,
    - Transport, and
    - A brief description of how the raw material and final products will be transported (to their point of sale inland or port of export) is required.
- Proposed river diversions including:
    - Topographical plans covering the original alignment, the new alignment and sufficient of the areas upstream and downstream of the proposed diversion so as to extend beyond the influence of the diversion,
    - Plans, cross-sections and longitudinal-sections showing the full scheme and nearby infrastructure,
    - Details of any linings, armouring or erosion control measures,
    - Details of hydraulic structures forming part of the diversion,

- Details of the beginning and end of the diversion showing the transition to the original natural watercourse,
- Details of points where storm water is expected to enter the diversion and the associated erosion control measures,
- A detailed description, including plans to the same level of detail as for the final diversion, of any intermediate or temporary steps which may be necessary to reach the final aim,
- Measures to maintain the long-term alignment (such as may be required where a diversion is located on unstable ground),
- Stratigraphic sections and engineering properties of the materials through which the diversion is to be constructed, and
- Flood lines for recurrence period of 1:20, 1:50, 1:100 years and the regional maximum flood for both the pre-diversion and post-diversion situation.

5.2. Project Alternatives

The project alternatives should analyze different alternatives to implement the project and to identify the alternative with the least impact on the environment. A good ESIA study would consider the alternatives for siting of mine facilities, ore beneficiation methods, methods of tailings disposal and the no-alternative option to protect public safety and minimize the impact on critical resources, such as surface waters, groundwater, or ecologically important wildlife habitat. It should answer the question: Is the chosen alternative the least environmentally-damaging practical alternative?

Mining siting - because the ore deposit exists where it is, alternative locations for the mine site are usually not negotiable with the mining companies except the method of mining such as surface mining to underground type mining to preserve surface resources. An underground mine might affect fewer human inhabitants and better protect surface waters, groundwater, or ecologically important wildlife habitat. If its location carefully selected, a wet tailings impoundment facility is the least environmentally-damaging practical alternative for tailings disposal. It should not be located near-critical water resources and should be located at a safe distance from residences and public buildings.

Processing methods - in contrast to mining siting, mining companies often have an option to choose of beneficiation methods to concentrate the desired metals in the metallic ore they have mined. The most common beneficiation processes include gravity concentration, milling and floating, leaching, dump leaching and magnetic separation. Some of ore beneficiation methods have less environmental and social impacts than others. As an example, gravity separation of gold ore has less potential to pollute the environment and threaten public health than cyanide leaching. However, the method of gravity concentration is applicable to few types of gold. Cyanide leaching is a relatively inexpensive method of treating gold ores and is the chief method that has a significant environmental impact as compared to gravity concentration. Thus, the ESIA should demonstrate that the beneficiation method preferred by the mining company is the least environmentally-damaging practical alternative.

Disposal siting - Mine tailings contain toxic substances in high concentrations. There are three main alternatives for the disposal of tailings: use of a wet tailings impoundment facility or tailing dam; dewatering and disposal of dry tailings as paste backfill or dry tailings disposal; and the release of tailings into the deep sea. Among these alternatives, the clear choice for the environment is dry tailings disposal which may cost more initially, but it has long-term cost effective with several advantages. If the ESIA does not propose the environmentally preferable dry tailings disposal, it must clearly demonstrate that dry tailings disposal is not feasible over the wet tailings impoundment in that specific environmental condition.

An ESIA for mining project is not complete without a comparative analysis of the environmental and social impacts of the "no-action" alternative (i.e. a future in which the proposed project does not take place). Many countries require an ESIA that contains a separate assessment of the "no-action" alternative. An assessment of the environmental and social impacts of a future, in which the proposed mining project does not take place, is very important to understanding what benefits might be lost if the proposed project does not move forward.

In general, it is important to focus on the following alternatives in ESIA study to choose the option with least impact on environmental and socio-economic environments:-

- Mining method,
- Mineral processing method,

- Transport, power and water supply routes,
- Sources of water,
- Mine infrastructure sites,
- Mine residue disposal sites.
- Domestic and mining waste disposal sites.
- Housing and camp sites.
- Land use options after rehabilitation.
- Alternatives to water and river diversions.
- The "No project" option.

6. BASELINE ENVIRONMENT

An environmental baseline study should clearly demonstrate the environmental and social conditions that the proposed mining project may disturb. The project proponents may have the interest to describe environmental conditions as already degraded or impaired or minimize the extent to which local communities inhabit and make use of the project area. However, an ESIA of a proposed mining project needs to contain a detailed discussion of environmental baseline data that adequately characterize the baseline conditions. The details about geology, surface water, groundwater, air quality, climatic conditions, ecosystem, cultural and historical resources and socioeconomic condition must be included in the ESIA baseline study to formulate appropriate monitoring plans and mitigation measures at the later stage.

6.1. Physico-chemical Environment

6.1.1. Geological and Topographic Settings

- The environmental baseline study should begin with a detailed characterization of the geological settings at the mine site, including the ore reserve and materials comprising the overburden,
- Understanding the geology condition of a mine site is not only important in the development of the target mine but also it is crucial in understanding the environmental setting for the ESIA,
- Information about the geologic formations in which the mine will be located and in the immediate vicinity of the mine should be provided in the baseline,
- Depending on the geology, there are various types of geochemical analysis a mining project must include to predict possible impacts on the environment, including the release of contaminants and acid drainage.

Characterization of mine materials depends on:

- Geology and mineralogy of the rocks at the mine site,
- Rock type and alteration,
- Primary and secondary mineralogy,
- The availability of acid-producing or neutralizing or metal-leaching minerals and
- The locations and dimensions of oxidized and unoxidized zones for all waste types.

An important part of baseline studies is to characterize the geochemistry of the waste rock, wall rock and ore in order to determine the potential for leaching of metals and other contaminants at the mine. This includes the potential for acid rock drainage (ARD) and acid mine drainage (AMD) as well as the potential for leaching under non acidic conditions. This takes a thorough understanding of the geology of the mine site including all stratigraphic layers to be encountered during the mining operation.

Waste rock, wall rock and ore should be analyzed for acidbase potential so that adequate systems can be designed to manage runoff and seepage for waste dumps, stockpiles and tailings. Different types of rock require different types of testing. For instance, prediction of ARD for low-sulfide, low neutralization potential mine wastes is methodologically different from that for normal sulphidic mining wastes and appropriate analytical methods should be chosen based on representative samples.

It is important to provide a topographic map of the development area at an appropriate scale with surface contours at an appropriate interval and describe topographic patterns and landforms with regard to elevation, and relief aspect.

6.1.2. Land use of the Project Area

ESIA baseline study should address the following related with the existing land use:

- Pre-mining land use and capability,
- Historical agricultural production,
- Evidence of misuse,
- Existing structures, and
- Post mining land use capability.

6.1.3. Climatic Condition and Air Quality

Understanding climatic condition at a mine site is important for the design of a long-term air monitoring program, developing a water balance for the site, and designing water/erosion control structures. Air quality condition in a project area is critical for evaluating the potential distribution of air pollutants and their effects in the area of influence. Air pollutants can travel long distances, so baseline air quality information should be considered in relation to meteorological conditions,

wind patterns, geological formation, and others that might influence the distribution of air pollutants. At the time of the baseline data collection, climatic data for local weather stations should be collected and analyzed. These data should include at least historic rainfall data in the past (precipitation, rainfall intensity, and duration), wind direction and speed, solar radiation, evaporation rates, barometric pressure, and temperature variations. For large mining proposals, if there is no data available near the mine site, a weather station should be established and baseline data should be organized for at least one year to reflect the seasonal changes at the site. All sampling sites and weather station locations should be depicted on a map in the ESIA. Baseline air quality should be conducted, both in the direction of the upwind and downwind side of the mining operation.

The following main points considering baseline air quality and climatic conditions should be addressed in the ESIA:

- A brief description of the regional climate;
- Mean monthly and annual rainfall for the site and number of days per month with measurable precipitation;
- Maximum rainfall intensities per month, storm events for the past five years and above;
- Mean monthly, maximum and minimum temperatures for the past three years and above;
- Monthly mean wind direction and speed - where appropriate hourly wind direction and speed for the past three years and above if possible;
- Mean monthly evaporation for the past three years and above; and
- Incidence of extreme weather conditions - frost, hail, drought, high winds for the past five years and above.

Since it is often unusual to have a weather station on a proposed mine site, data for the site may have to be deduced from stations around the site.

Baseline air quality analyses should include measurements of the following common parameters:

- Particulate matter (PM10 and PM2.5),
- Carbon monoxide (CO),
- Nitrogen oxides (NOx),
- Lead (Pb), cadmium (Cd), arsenic (As), mercury (Hg),

- Total Suspended Solids (TSS), and
- Sulfur dioxide (SO2).

6.1.4. Seismicity

If a mining project involves wet tailings impoundment dams, the ESIA must adequately characterize the existing seismic conditions for tailing dams, including the risk of a major earthquake that could damage mine facilities that cause catastrophic consequences, such as a tailings dam failure. The design of any tailings dams usually has to consider potential seismic activity at the site. This implies the tailing dam design should take into account the design earthquake for the site in question. To obtain this, it is important to conduct a proper seismic hazard analysis for the site. A method commonly used to determine the effects of the design earthquake on a particular site is to assume that the earthquake occurs on the closest known seismic source zone or possibly active fault. The ESIA should include the impact of the design earthquake for the mine site and assess its potential impact on mine facilities, including the tailing dam (if one is proposed) and underground opening for subsurface mines. The description of the design earthquake for the tailings dam should be based on the most complete and recent seismic data.

The following recommendations are given for tailing dam seismic consideration:

- Where the project site is located in areas where there is a risk of high seismic loadings, the independent review should include a check on the maximum design earthquake assumptions made for tailing dam and the stability of the structure to ensure that the design is such that during seismic events there will be no uncontrolled release of tailings;
- Site-specific risks/ hazards associated with geotechnical stability of hydraulic failure and the associated risks to downstream economic assets, ecosystems and human health and safety should take into account.

6.1.5. Surface Water Quantity and Quality

Most of the mining operations not only affect surface water quality but also use a significant quantity of water for the mining process that can cause water stress in the project area. Thus, characterizing existing surface water quality and quantity during the ESIA baseline study should provide detailed information on the location, distribution, quantity, and quality of all water resources that could be affected by a project and its alternatives. The analysis should have a

reasonable level of detail, to help understand the conditions of the environmentally significant geographic areas particularly in line with water pollution.

Baseline studies considering water quality should consider the local and regional uses of water (domestic, industrial, agricultural, and others) and evaluate water quality as part of the ecosystem in relation to the life of plant and animal communities. Water quality studies should be compared to local and international standards and other legal guidelines for each water uses. Quantity must reflect several aspects such as watershed distribution, hydrological processes, and the availability of different water users at local and regional scales.

Detailed hydrological characteristics of all surface water resources in the project area and in the area of influence including seasonal variations and maximum floods for different return periods must be identified. Different maps showing locations and characteristics of river basins, lakes, and streams should be developed. Existing surface water pollution sources; locations and volume of flows should be identified in the study. It is important to identify wetlands, flood zones and minimum flow rates. Physical and chemical parameters commonly used for water quality measurement should be identified such as: pH, turbidity, suspended solids, temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved solids, salinity, conductivity. Common contaminants of concern include ammonia, arsenic, cadmium, copper, chromium, cyanide, iron, lead, manganese, mercury, molybdenum, nickel, nitrate/nitrite, sulfate, thallium, uranium, vanadium, and zinc.

When baseline surface water quality samples are collected, they should be analyzed for the full suite of parameters and contaminants of concern listed above, and any others that are known to be common in the project area or specific to the proposed extraction and beneficiation methods.
ESIA study must include water sampling methods, and the number and exact location of sampling points. Water quality data should include laboratory analysis results. The impact of mining on the quantity and quality of surface water should take into account the cumulative impacts of other mines, different land uses, industry, etc. located in the same watershed. A watershed based mine discharge impact assessment approach would be similar to that related to permitting a discharge

using a watershed approach. It determines the nature and extent of pollutants discharged throughout the watershed and potential additional pollutants discharge from the proposed mine.

6.1.6. Ground water

Mining operations can affect groundwater resources. Depending on the area, groundwater can be located at shallow depth with strong interaction with surface waters, or deeper with low or no interaction with surface water. Groundwater can be used for various purposes, such as agricultural, domestic supply, and industrial. An ESIA baseline study should include the following basic information about groundwater resources:

- Depth to groundwater during the dry and wet season;
- Hydrogeological characteristic of the aquifers, thicknesses, and hydraulic conductivity;
- Groundwater flow directions;
- Locations/flows of springs and seeps;
- Locations of groundwater discharge points to streams;
- Groundwater uses and existing well sites and discharge rate if any; and
- Physical and chemical parameters commonly used for ground water quality measurement should be identified and analysed.

6.1.7. Wetlands

Location of wetlands (marsh and swampy) in the project area and extent should be addressed in the ESIA baseline survey.

6.1.8. Soil Quality

Mining operations can expose soils to erosion and contamination. Soil erosion can be a source of contamination to air and water bodies. Avoiding major impacts on soil can limit the degradation of the whole ecosystem. During the ESIA baseline study, it is important to collect information on the erosion potential of the soils, the chemical composition of each soil layer, and the presence of suitable soils for later use during site restoration. For sites that have available soil maps, these should be properly described. If there is no soil map, a soil survey should be conducted showing soil type, grain size distribution, engineering properties, depth of various horizons, erosion potential, vegetative growth potential, etc. Soil sampling information should take into account a reasonable number of sampling points representative of the mining concession area. Laboratory

analysis should provide information about soil composition, soil strength, soil nutrient status (potassium, calcium, magnesium, nitrogen, and phosphorus), heavy metals (lead, copper, zinc, cadmium, mercury, and chromium) mineral content, cation exchange capacity and pH. Particular attention should be given to studying soil structure and chemistry since such soils are very sensitive to degradation.

6.1.9. Noise and Vibration

Existing noise levels on and around the project site should be identified as well as potential noise impact sites. If the potential impacts warrant it, pre-mining noise monitoring may be required. Similar exercise should be done for vibration.

6.2. Biological

6.2.1. Natural Vegetation (Flora)

ESIA baseline study for natural vegetation/plant life/ should address the following:

- Describe the project area vegetation,
- List out general and dominant species,
- Endangered or rare species,
- Intruder or exotic species,
- Illustrate the location and document the area of the various vegetation types and forest types that will be disturbed by the project,
- Sensitivity to disturbance,
- Document the type, location, quantity and capability of habitat that will be disturbed or lost as a result of the project,
- Densities and distributions,
- Historically important specimen,
- Fire potential,
- Animal habitat value,
- Watershed value,
- Timber value,
- Specimen of scientific or aesthetic interest,

- Check whether the site or surrounding area falls within a protected zone for biodiversity at a local, national, regional or international level,
- Timing of important seasonal activities (nesting, breeding, migration, etc.) for species that could be affected by mining activities, and

6.2.2. Animals (Fauna)

Provide an inventory of wildlife resources in the development area, including items such as species, composition, distribution and abundance including:

- List out general and dominant species (mammal, fish, fowl, etc.),
- Densities and distribution,
- Habitat (general),
- Rare or endangered species,
- Migratory species,
- Migration route and staging areas,
- Habitat evaluation, distribution, and utilization including critical habitat,
- Regional and local significance of populations,
- Sensitivity to disturbance,
- Document the type, location, quantity and adaptability of habitat that will be disturbed or lost as a result of the project,
- Commercially valued species,
- Game species, and
- Streamside conditions (habitat conditions and stream flow rate).

6.2.3. Ecosystem and Ecosystem Services

The Millennium Ecosystem Assessment report 2005 defined ecosystem services as benefits people obtain from ecosystems and distinguish four categories of ecosystem services, where the so-called supporting services are regarded as the basis for the services of the other three categories.

i. Supporting services

These include services such as nutrient cycling, primary production, soil formation, habitat provision and pollination. These services make it possible for the ecosystems to continue providing services such as food supply, flood regulation, and water purification.

ii. Provisioning services

The following services are also known as *ecosystem goods*

- Food (including seafood and game), crops, wild foods, and spices,
- Raw materials (including lumber, skins, fuel wood, organic matter, fodder, and fertilizer),
- Genetic resources (including crop improvement genes, and health care)
- Water purity,
- Biogenic minerals,
- medicinal resources (including pharmaceuticals, chemical models, and test and assay organisms),
- Energy (hydropower, biomass fuels),
- Ornamental resources (including fashion, handicraft, jewelry, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)

iii. Regulating services

- Carbon sequestration and climate regulation,
- Predation regulates prey populations,
- Waste decomposition and detoxification,
- Purification of water and air,
- Pest and disease control, and
- Flood protection.

iv. Cultural services

- Cultural (including use of nature as motif in books, film, painting, folklore, national symbols, advertising, etc.),
- Spiritual and historical (including use of nature for religious or heritage value or natural),
- Recreational experiences (including ecotourism, outdoor sports, and recreation),
- Science and education (including use of natural systems for school excursions, and scientific discovery), and
- Therapeutic (including eco-therapy, social forestry and animal-assisted therapy).

v. Socio-economic

The ESIA should define the existing socio-economic conditions in the vicinity of the mine. All activities, and social and economic processes, that could be influenced directly or indirectly by the mining development addressed under the socio-economic environment. In most cases, there is a defined socio-economic environment that will be affected by the project.

The section of an ESIA that includes the socio-economic baseline data should explain how the scope of the analysis was defined and how the study area was delineated. The level of detail needed for the socio-economic baseline can be highly variable depending on the project size and type. The section should include the following information on the proposed mining site.

6.2.4. Demography

- Location of the local inhabitants with respect to the proposed project site,
- Population characteristics (size, gender, growth and age distribution),
- Cultural characteristics (religion, language and ethnic composition, etc.),

6.2.5. Livelihood and Economic Activities

- Quality of life (housing quality and quantity),
- Existing land-use patterns and farmland,
- Skills, services and goods available in the communities, and
- Employment and incomes sources,

6.2.6. Infrastructures

- Health service
  - Number of health institutions (Hospital, health center, health posts, clinics, laboratory center, rural drug shop, pharmacy, etc.),
  - Identify number of the institutions as private, governmental, NGOs,
  - Identify any of the institutions present in the kebele of the project area,
  - Identify ratio of people to the number of hospital and health center based on the health center standard of the country,

- Maximum km to get health services from nearest health service center,
- Family planning coverage
- Evaluate data with the National Health Service coverage standard and write a paragraph or two on collected data and health service conditions.
- Diseases prevalence (top ten diseases).

- Education status (access, public and/or private and average level),
- Telecommunication
- Road
- Utilities (water and electricity) Community services and organizations, Public safety (police, fire, etc.),

6.2.7. Protected Area, Cultural and Historical Resources

The protected area, cultural and historic resources that should be included in the Environmental baseline study are archeological and historical sites and structures and traditional cultural lifestyles and properties associated with those lifestyles. All cultural or historical sites/resources in the vicinity of the mine should be identified and mapped. These may be structures or sites, including:

- Historic buildings,
- Archeological sites,
- Burial grounds,
- Sacred or ceremonial sites,
- Sites used for the collection of materials used in ceremonies or traditional lifestyles,
- Sites important because of their roles in traditional stories,

During the environmental baseline study, a discussion should be made with the local community on whether the site or surrounding area has important traditional or cultural value.

6.2.8. Disaster risk

Disaster risk is a potential factor in many development projects including mining operations. It can affect a mining project site with high socio-economic consequences. The development of a mining projects can increase or reduce the risk, through their impact on social resilience and the natural environment. By understanding and anticipating future hazard events during the baseline study, communities, public authorities and development organizations can minimize the risk disasters pose to socio-economic development.

The main natural disaster risks which should be addressed in the baseline study include:

- Drought (intensities and frequencies),
- Flood (intensities and frequencies),
- Earthquake (magnitude and intensity),
- Landslide (zone of potentially unstable slopes and maximum size estimate),
- Volcanoes (active, dormant or extinct),
- Subsidence (size and specific locality),
- human and livestock epidemic disease like COVID 19,
- Possibility of liquefaction, and
- Wildfire.

7. IMPACT ANALYSIS

Environmental impacts from mining can occur at local, regional, and global scales through direct and/or indirect mining practices. Impacts can result in soil erosion, development of sinkholes or subsurface cavity, loss of biodiversity, contamination of soil, pollution of groundwater and surface water bodies by the chemicals emitted from mining processes. These processes also have an effect on the atmosphere from the emissions of carbon which have an impact on the quality of human health and biodiversity. In most of the cases, the environmental impacts may last for years or decades after the closure of the mine or are irreversible (US EPA, 2011). These impacts are site-specific and determined by the geology, hydrology, hydrogeology, climate, and human and wildlife populations at proximal distance to the mine. Some mining methods may have such significant environmental and public health effects over the others that mining companies in some countries are required to follow strict environmental and rehabilitation codes to ensure that the mined area returns to its original state (Namin and Bascetin, 2020).

Impact identification is a critical step in an ESIA. The process usually consists of two stages. First, exhaustive list of all impacts including direct and indirect impacts are discussed. Then significant impacts are selected based on magnitude, geographical extent, duration, frequency, reversibility and special sensitivity for further study.

Impact can be categorized into;

- Long/short term,
- Local/ regional/ national/ global,
- Direct/indirect, and
- Irreversible/reversible.

The ESIA should define direct, indirect and cumulative impacts as follows:

- **Direct impacts** are due to a specific project- related activity in the same place and time as the project,
- **Indirect impacts** are due to actions resulting from direct impacts, but occur outside the time and space for the project including impacts whose cause may be several times removed from project actions,

- **Cumulative impacts** are the incremental impacts of the proposed project when added to past, present and future activities and their impacts on a particular resource.

The subsequent sections review the potential impacts of mining

7.1. Beneficial Impacts

Positive impacts of mining include:

- Increased individual incomes;
  - Direct employment at the mine,
  - Increased purchases from local businesses, and
  - Other economic activities stimulated in the community as a result of the mine.
- Employment opportunities (short- term and long- term for local residents);
- Workers trained and provided with health and safety equipment;
- Increased tax base;
- Resource royalties;
- Foreign currency; and
- Opportunity for a community development agreement with the mining company.

7.2. Adverse Impacts

7.2.1. Physicochemical

i. Topography

Mining activities and its facilities such as excavation, blasting, drilling, overburden, waste dumps and tailings storage facilities are results major changes to the landscape. Mining operations, and in particular surface mining activities, may result in negative visual impacts to resources associated with other landscape uses such as recreation or tourism.

ii. Surface Water and Ground water

Mining projects have a significant impact on water quality and availability of water resources in the project area. Defective mining practice is one of the main anthropogenic sources of water pollution which release a large amount of pollutant into the water resource. Water pollution is the

state of deviation of water from pure condition due to physical or chemical changes in water which makes it harmful to health and the environment. The key question is whether surface and groundwater supplies will remain fit for human consumption and the quality of surface waters in the project area will remain adequate to support native aquatic life and land-dwelling wildlife.

There are numerous types of pollutants that can be released into surface water and groundwater from a mining operation. These include suspended solids and toxic pollutants including metals, nitrates, cyanide, and other contaminants. There are various processes in which these contaminants can be released into surface water and/or groundwater from a mining operation. These include:

a) **Erosion of sediments and deposition in surface water** mining operations usually expose extensive land surface with different layers of rock and soil units to the surface water erosion. Water erosion can either be caused by the direct impact of raindrops, by channel flow forming rills and gullies, or by sheet flows. Through these processes of erosion sediment enters streams and lakes impacting fish and aquatic plant life, rising lake levels and clogging waterways. In addition, erosion can be caused by wind, which can directly enter into surface water or indirectly deposit on land from which it is subsequently moved into surface water during runoff events. Sediment and dust may also be loaded with metals and other contaminants which may be released during transport or deposition.

b) **Acid mine drainage into surface water and groundwater.** Acid Mine Drainage occurs when sulfide containing minerals like pyrite, which is common to many mine sites, are exposed to air and water and form acids. The process is called Acid Mine Drainage (AMD) in the mine and Acid Rock Drainage (ARD) in the waste rock and tailings piles site. Sulfide containing minerals, which may be naturally occurring in the ore deposit, waste rock and wall rock, may react with water and oxygen to create ferrous ions and sulfuric acid. Together with bacteria acting as a catalyst, the ferrous ions react further with oxygen, producing hydrated iron oxide. The combination of iron oxide and sulfuric acid can contaminate surface water producing a low pH value and a high concentration of sulfate, iron, and heavy metals. Some metals and metalloids and other contaminants may also be released under non-acid conditions. The resulting contamination of surrounding water resources with acids, dissolved metals, metalloids and other contaminants can kill plants

and fish and, in serious cases, poison humans who drink contaminated water or eat fish and plants from polluted rivers and streams.

c) Failure of tailing impoundments/dams and leakage or spilling of contaminant into surface water

In most of mine sites, potentially hazardous materials are transported to mine sites and stored within tailings ponds/dams. Seepage or spilling can release potential contaminants to the environment. This can happen as a result of a transportation accident, pipeline failure, tailings dam failure and leakage from tailing impoundment. As a result contaminants such as cyanide, sulfuric acid, pregnant solution, petrochemicals, or solvents could spill/leak into nearby surface waters.

d) Mine Area Dewatering

When a mine or ore body intersects the water table, groundwater flows into the open pit or underground mine structures. To create a workable environment and proceed with mining, the groundwater must be pumped out of the mine site. As a second alternative, water may be pumped from wells surrounding the mine for reducing inflow. Pumping and discharging mine water causes major environmental problems. During mine operation phase, mine water must be continually removed from the mine to facilitate the removal of the ore. Once mining operations end, the pumping and management of mine water usually end result in an uncontrolled release to the environment.

e) Mine Water Use

Most of mining companies use a significant amount of water of surface or groundwater for the operation. This can affect the local community and also the whole ecosystem due to water stress which resulted from limited water resource availability in the project area. Groundwater drawdown and associated impacts to surface waters and nearby wetlands can be a serious concern in some areas. Impacts due to groundwater drawdown may include reduction or elimination of surface water flows; degradation of surface water quality and beneficial uses; degradation of habitat (not only riparian zones, springs, and other wetland habitats, but also upland habitats as groundwater levels decline below the deep root zone);

reduced or eliminated production in domestic supply wells; water quality/quantity problems associated with the discharge of the pumped groundwater back into surface waters downstream from the dewatered area. The impacts could last for many decades. While dewatering is occurring, discharge of the pumped water, after appropriate treatment, can often be used to mitigate adverse effects on surface waters. In general, there is a potential to impact surface water and groundwater in various phases of mining activities starting from site preparation (deforestation, erosion and subsequent sedimentation and acid rock drainage) to after the closure of the mine.

i. Wetlands

Impacts to wetlands due to mining activities may occur directly or indirectly. Direct impacts include wetland destruction for surface mining development, draining as a result of mine dewatering or changes in swampy, marshy, stream flow or aquifer conditions, or filling as a result of the construction of a tailings impoundment or waste rock dumps. Sedimentation can also impact wetland resources as a result of uncontrolled runoff and erosion from the mining site or scouring and head cutting from poorly designed stream diversions or discharge outfalls. Indirect impacts on wetland resources can occur from increased human activities in those habitats, including recreation and gathering of plant materials for food, construction, fuel or medicinal uses.

ii. Air Pollution

Air pollution can occur at mining sites such as during excavation, beneficiation, and transportation. One of the main air pollutions is from dust created at different stages of the mining process such as: site clearing, access road construction, excavation, blasting, crushing, grinding, dumping and transportation. Despite the attempts to control dust in the mining industry, there are areas in mining operation where there are elevated dust concentrations. Smaller particle size dust can be carried by wind for great distances and may be deposited in residential areas. It may contain heavy metals that can affect human health and/or cause environmental problems through direct inhalation, soil deposition, and deposition on plants or accumulation within a water body.

The list of common potential gas emission sources in mining industries are the following:

- Gas exhaust from equipment/machinery used in mining development and transportation of materials (carbon monoxide, unburned volatile organic compounds/hydrocarbons, nitrogen oxides and sulfur dioxide result from fuel combustion in vehicles, heavy equipment including crushers, grinders, and generators associated with mining),
- Gases from explosives used in blasting operations,
- Sulfides, hydrocarbons, and other gas emissions from vents in underground mining operations,
- Gas emissions from drying operations in ore processing (drying of pulp and/or sediment materials during ore processing),
- Gold and silver leaching operations can produce hydrogen cyanide gas,
- In addition, modern techniques require the use of a variety of hazardous chemicals for ore processing such as acids and cyanide, which, in the event of an accidental spill can result in fumes that can impact mine employees and nearby residents,
- Thermal processes such as autoclaves, roasters, and carbon regeneration kilns can release mercury and other hazardous air pollutants,
- Fugitive emissions during ore processing (uncontrolled leaks in equipment such as valves, pump seals, and others that enter the air without going through a smokestack a pollution control device),
- Smelter emissions, smelting, without controls, can produce a large amount of particulate matter and heavy metals. Thermal processes also can release significant amounts of mercury, which can then be deposited locally or regionally, or can contribute to global atmospheric mercury.

The impacts analysis section of the EIA must integrate the baseline data (environmental conditions before the project) with the assessment of potential impacts on air quality in all projects. For underground operations, a serious hazard results from exhaust gases released by vehicles and mining equipment as well as from fumes produced during blasting. These exhausts produce carbon monoxide and nitrogen oxide gas that can collect in underground cavities. Workers exposed to high concentrations of these gases risk serious illness and death.

iii. Noise and Vibration

Explosives and heavy machinery are used regularly at mining sites, resulting in potentially harmful levels of noise pollution. Miners subject to high noise levels for extended periods of time may become permanently deaf. Noise also can affect wildlife by causing stress and disrupting behaves.

Explosives used for excavation in mining causes significant vibration. Control of vibration damage to natural formations and manmade structures is therefore an important environmental consideration. Damage to natural formations has been observed up to 500 meters away from blasting sites. Many mines including quarry sites for construction material in a city limit the number or weight of explosions, using millisecond delays between blasts to minimize the impact of ground vibration and noise, especially near population centers, natural scenic formations, wells, and stream channels.

iv. Soil Health

Surface and underground mining operations can significantly affect soil physical and chemical properties. Mining activities can aggravate soil erosion by means of wind and water. Soil erosion in mining projects due to wind and water occurs on surface disturbances associated with surface mining operations and underground operations and by runoff associated with the discharges of mine water. Mining activity can also contaminate soil by leaching solutions, solvents, fuels, and mine water. When mine water runoff, and drainage from waste rock piles, tailing ponds and beneficiation facilities come in contact with soils, toxic metals and other hazardous materials in these waste streams can be transferred to the soils. Common soil contaminants from mining include heavy metals (cadmium, lead, etc.), arsenic, and radionuclides. Contact of acid rock drainage with soils can lower both the pH and the cation exchange capacity of the soils. Contaminated soil can affect restoration of mine site and can cause illness if directly handled or ingested by humans.

v. Land Use

Mining may affect local land use. Clearly, land use on the mining site itself will be modified for the life time of the mine, and in many cases, for years after mine closure. Some impacts may only occur during the life of the mine, and can be re-established after mine closure, such as livestock grazing, wildlife habitat, hunting, and agriculture. However, in some areas of the mine (for instance on waste piles and in open pit excavations) even some of these uses may not be reestablished for

many years after mine closure. These impacts become long term impacts. Other long term impacts can include those associated with roads, rails and other ancillary facilities that may stay in place and be used after restoration.

Mining can impact land use on properties adjacent to the mine as well as properties through which mining roads, rails, or other conveyances may pass. Land use in these areas can be impacted by visibility, noise, odor, air pollution, and water contamination. Mining can also result in indirect impacts on land use caused by increased pressure on natural resources. A mining operation needs employees and those employees need support facilities, all of which in turn increase the population in the area, with associated increased pressures on natural resources and land uses in the vicinity of the mine. The development of new roads also may open up previously inaccessible areas to development.

7.2.2. Biological

i. Flora

The key direct impact of mining is the removal of bushes, shrubs, vegetation and canopy cover. Indirect impacts include road-building and pipeline development, which may result in habitat fragmentation and increased access to remote areas. While larger intact forest ecosystems may withstand the impacts of mining and oil development, smaller fragments are likely to be particularly sensitive to clearing.

ii. Fauna

The removal of forest ecosystem and pollution caused by mining activities leads to the destruction of terrestrial and aquatic species, extinction of endangered and endemic birds, fish and animal species.

Terrestrial life

Mining impacts to terrestrial life include:

- Habitat loss, degradation and alteration associated with the destruction of vegetation,
- Disturbance of migration corridors by mining activities and transport system (roads, rails, pipelines, conveyers, etc.),
- General displacement from surrounding due to increased noise and human activity,

- Increased mortality in relation with contamination of soil, vegetation and water, direct contact with solution ponds and tailings impoundments, and direct animal hits by mining or commuting vehicles,
- Increase in human activities for recreation or hunting in surrounding result in reduction of wildlife habitat, and
- Development of new access roads for mining wider impact on terrestrial ecosystems.

Aquatic Life

Changes in water quality by mining operation affect aquatic resources by increasing the loading of sediment or toxic/hazardous materials (metals) to streams and water bodies, decreasing the oxygen in the water, and/or changing the temperature. Mine water dewatering and disrupting flows into wetlands or other water bodies can also impact aquatic habitats. The impacts may result in changes to the relative abundance of species or biological diversity in the ecosystem. Cyanide, widely used in silver and gold leaching operations in mine, can significantly impact aquatic ecosystems. Cyanide may mobilize heavy metals when it released to the soil, surface water or groundwater. Thus, cyanide in ponds and ditches as well as spills/seeps from tailing dams contaminate soil and get into runoff presents a hazard to aquatic plant and animal life. Aquatic ecosystems can also be impacted by mining operation due to increases in resource demands (such as overfishing due to increase in population), secondary impacts (such as clothing washing or recreational use) and displaces species or disrupts habitats.

7.2.3. Ecosystem Services

The ecosystem provides supporting (soil formation, biodiversity, primary production, habitat and etc), provisioning (food, fiber, fresh water, timber, medicinal, etc.), regulating (climate regulation, pollination of crops, carbon storage, control flooding, etc) and cultural (recreation, spiritual value, aesthetic value, etc.) services.

Forest degradation, water pollution, water withdrawal, soil pollution, air pollution, noise, etc from mining activities lead to adverse impacts on the ecosystem services.

7.2.4. Climate Change

Coal mining is both energy-intensive during extraction and emits large amounts of GHGs during its use leading to increased climate change impacts. Deforestation due to the development of mining projects also cause an increase in GHG emissions and emissions from fuel used in mining and processing, transportation, fugitive emissions, from refining and smelting

7.2.5. Socio-Economic

The socio economic adverse impacts can vary by location and size of the mine, length of the project from construction to closure, manpower requirements, the opportunities the mining company has for the local community employment and involvement, and the existing character and structure of the community.

Negative impacts of mining include:

- Demography like increase population, increased crime (drugs, alcohol, etc.) and prostitution,
- Livelihood and Economic Activities - displacement or disruption of people's livelihoods (example: fishing, hunting, grazing, farming, forestry), reduction in quality of life for residents from visual and noise impacts, displacement and relocation of current residents or community resources, creation of a mining camp may break up family units, etc.
- Infrastructures - increased traffic and truck trips (safety, noise, exhaust), the strain on existing houses, infrastructure, and services as a result of increased population, public finance requirements. more infrastructures may need to be built and maintained to meet the demands of an increased population for public education and public services (water, sanitation, roads, etc.),
- Public Health - dust, fume exhaust, noise, direct contact with contaminated soils, and explosives all pose a human health risk to workers. Nearby communities may also be affected by dust, releases of toxic chemicals in water supplies, bioaccumulation of toxics in fish eaten by residents, and toxic chemical spills due to transportation accidents,
- Occupational Health and Safety - the contamination of water, air and soil. The people most susceptible to the environmental impacts of mining are the workers.

7.2.6. Cultural and Historical Resources

Impacts on cultural, ceremonial and historic resources include any direct or indirect alteration of archeological and historical sites or structures or traditional cultural lifestyles and resources associated with those lifestyles. Cultural and historic resources include: archeological sites, historic buildings, burial grounds, sacred or ceremonial sites, areas used for the collection of materials used in ceremonies or traditional lifestyles, and sites that are important because of their roles in traditional stories.

Examples of adverse effects to cultural and historical resources from mining include:

- Damage and alteration of historical resources,
- Removal from historic location,
- Introduction of visual or audible elements that diminish integrity, and
- Neglect that causes deterioration.

7.2.7. Disaster Risks

Disaster risks cause by natural phenomena or climate change impacts are:

- Landslide,
- Drought occurrences,
- Flood occurrences,
- Crop pests,
- Earthquake,
- Wildfire, and
- Volcanoes.

7.2.8. Impact of Artisanal Mining

Artisanal miners and small scale miners sometimes tend to do more damage to the environment than large scale mining. These include:

- Digging and creating of:
    - Embankments,
    - Trenches, and
    - Excavated pits,

- Landslides,
- Tailing pile in river beds,
- Deforestation,
- Dust production,
- Waste mineral resources,
- River siltation,
- Exposure to chemicals, heat and lack of oxygen
- Erosion damage,
- Social unrest,
- Effect on the ecosystem,

Artisanal mining license holders are not required to submit the environmental impact assessment document or related environmental management plans as a prerequisite for license issuance (Mining operation proc. No.816/2013), but this guideline propose short and brief environmental assessment for artisanal mining is attached in annex xi.

8. ENVIRONMENTAL AND SOCIAL MITIGATION AND ENHANCEMENT PLAN

Mitigation of mining impacts involves siting issues, technological solutions to avoid or minimize contamination, and restoration programs. Most important for mineral mining is the siting of mining operations and tailing ponds to avoid the effects on habitats of concern, wetlands, riparian areas, and groundwater recharge areas. A recommendation of specific mitigation measures depend on the type of mining and the specific process causing impacts. It is generally best to minimize the area affected by mining as it is unlikely that even the disrupted soils and sediments can be restored. This section reviews mitigation measures and management plans needed to limit potential mining impacts on environmental, social, economic and cultural resources.

Mitigation measures are required for a mining operation to reduce impacts of the mine to the affected environment: water, air, land, soil and geologic, biologic, land, cultural, visual and human resources. It is recognized that it is seldom possible to eliminate an adverse environmental impact altogether, but it is often feasible to reduce its intensity. This reduction is referred to as mitigation.

8.1. Mitigation Measures for Water Resources

To protect water resource from mining projects impacts and to avoid related consequences, the following key mitigation measures must include in the ESIA study:

1) **Acid mine drainage -** there must be a clear design measure to prevent acid mine drainage (AMD) from the beginning by preventing sulfides in wastes and exposed geological materials from being converted to sulfuric acid. In addition, measures that are designed to minimize the impacts of AMD, by treating it after it occurs, should be in place. The treatment of AMD must go on for long time. Therefore, ESIA should emphasize mitigation measures that prevent acid mine drainage from ever starting.
2) **Surface Water Runoff Management -** water is one of the main means of transport to carry pollutants into the wider environment. As a result a comprehensive and accurate understanding of meteorological and hydrological conditions at the project site is important for a mining company. This must be demonstrated in the ESIA to determine the nature of water movement throughout the mine site which is indispensible.

3) **Sediment and erosion -** erosion of soil and mine wastes into surface waters is serious, with adverse environmental consequence of mining projects. Key issues with storm water management are:
    - To minimize run-off;
    - To avoid erosion of exposed ground surfaces;
    - To prevent sedimentation of drainage systems and
    - To minimize exposure of polluted areas to the storm water.

Recommended storm water management strategies include:

- proper placement of soil and rock piles to reduce exposure of sediment generating materials to water or wind,
- Divert surface runoff from undisturbed areas toward the disturbed areas,
- Use of settlement ponds to avoid or prevent off-site sediment transport,
- Protection of storm water drains, ditches, and stream channels against erosion,
- Installations of temporary drainage system that designed, constructed, and maintained for recurrence periods

Recommended management strategies after construction include:

- Establishing riparian zones;
- Timely implementation of a proper combination of contouring techniques, terracing, slope reduction /minimization, runoff velocity limitation and appropriate drainage installations to reduce erosion in both active and inactive areas;
- Access and haul roads should have gradients or surface treatment to limit
- Erosion and road drainage systems should be provided;
- Facilities should be designed for the full hydraulic load,
- Storm water settling facilities should be designed and maintained according to internationally accepted good engineering practices,
- Sediment control facilities should be designed and operated for a final Total Suspended Solids (TSS) discharge of 50 mg/l and other applicable parameters, and
- From mine operations onwards, recommended management strategies include final grading and re-vegetation of disturbed area.

4) **Management of waste rock dumps** - waste rock and the overburden is often disposed in constructed waste rock dumps. Management of these dumps during the mine life cycle is important to protect human health, safety and the environment. The following measures are recommended for the management of waste rock dumps for the protection of water quality.
    - Dumps should be planned with appropriate terrace and lift height specifications depending on the nature of the material and local geotechnical considerations to reduce erosion and reduce safety risks;
    - Management of Potentially Acid Generating (PAG) wastes should be carried out as described in the guidance;
    - Possible change of geotechnical properties in dumps, that can reduce the dumped spoils significantly in grain size and mineralogy, because of chemical or biologically catalyzed weathering should be considered; these changes in geotechnical properties will result in high ratios of clay fraction that significantly decreased stability towards geotechnical failure;

Thus, the design of new dump facilities has to provide possible measures for such potential weakening of the geotechnical properties with higher factors of safety. Safety assessments of existing facilities should also take these potential changes into account. The Environmental management plan should include a detailed discussion of how it would incorporate the above measures to prevent water quality impacts of overburden and waste rock dumps.

5) **Controlling of open pits to prevent water ponding -** since surface water storage in open mine pit can cause substantial environmental impacts. Mining companies should not allow a lake to form in an open pit. Instead, open pits should be properly backfilled. The EMP should include how the open pit would be managed in a manner that would allow for its backfilling and eventual re-contouring and re-vegetation, to reconstruct the pre-mining conditions.
6) **Managing wet tailings impoundments -** dewatering of tailings and their use as backfill is the environmentally-preferable mining waste disposal option. As such, the environmental

management plan would not need to discuss the management of a wet tailings impoundment, the EIA calls for the creation of a wet tailings impoundment/dam. Seepage control and related stability analysis should be a key consideration in the design and operation of tailings dams. This is likely to require a specific piezometer based on monitoring system for seepage water levels within the embankment and downstream of it, which should be maintained throughout its life cycle. Consideration of zero discharge tailings facilities to the downstream and completion of a full water balance and risk assessment for the mine process circuit including storage reservoirs and tailings dams. Design of tailing dams should take into account the probable maximum flood event and the required freeboard to safely contain it and others site-specific risks such as seismic hazard. The EMP discussion of how the wet tailings impoundment (if one is proposed) would be managed in consistent with the above principles should be included.

7) **Management of leach facilities -** according to the IFC/World Bank Group recommendation the following measures for the management of leach facilities are important for protection of water quality:

- Mining companies should design and operate surface heap leach processes so that the infiltration of toxic leach solutions should be prevented through the provision of proper liners and sub-drainage systems to collect or recycle solution for treatment, and minimize ground infiltration;
- Pipeline systems that carry pregnant solutions should be designed with secondary bunded containment;
- Leakage detection equipment should be installed for pipeline and plant systems with appropriate leakage response systems in place;
- Process solution storage ponds and other impoundments designed to hold mining water or non-treated leach process effluents should be lined, and be equipped with sufficient wells to enable monitoring of water levels and quality.

Recommended practices for the managing leach-pad waste include the following:

- Leachate collection and treatment should continue till the final effluent criteria are consistent with guideline values

- Decommissioning of leach pads should utilize a combination of surface management systems, seepage collection, and active or passive treatment systems to ensure post closure water resource quality.

8.2. Mitigation of Air Pollution

Management of ambient air quality at mining project sites is important at all stages of the mine cycle. Airborne emissions may occur at different stage of the mine cycle (during exploration, development, construction, and operational activities). The principal sources of emissions include fugitive dust from blasting, exposed surfaces such as tailings facilities, stockpiles, waste dumps, haul roads and infrastructure, and to a lesser extent, gases from the combustion of fuels in stationary and mobile equipment. The environmental management plan should discuss measures for the control of air pollution, including specific measures to control fugitive dust, noise, and ground vibrations.

Control of fugitive dust emissions (FDE) - FDE from the dry surfaces of tailings facilities, waste dumps, stockpiles and other exposed areas should be minimized.

The recommended dust management strategies include:

- Use of dust suppression techniques (e.g. wetting down, use of all-weather surfaces, etc.) for roads and working areas, optimization of traffic patterns, and reduction of travel speeds;
- Re-vegetate or cover exposed soils and other erodible materials promptly;
- New areas site clearing should be done only when absolutely necessary;
- Surfaces should be re-vegetated unless rendered with non-dust forming when inactive;
- Storage facilities for dusty materials should be enclosed or operated with efficient dust suppressing measures;
- Material loading, transfer, and discharge should take place with a minimum height of fall, and be shielded against the wind, and consider the use of dust suppression spray systems;
- Conveyor systems for dusty materials in the mine should be covered and equipped with measures for cleaning return belts.

8.3. Mitigation of Noise and Vibration

The main sources of noise emissions associated with mining may include noise from vehicles, loading and unloading of rock into steel dumpers, chutes, power generation, and other sources related to construction and mining activities. Additional noise sources in mine include shoveling, ripping, drilling, blasting, transport (including corridors for rail, road, and conveyor belts), crushing, grinding, and stockpiling. Appropriate prevention and control of noise sources should be established based on the prevailing land use and the proximity of noise receptors such as communities or community use areas.

Recommended management strategies for noise and vibration control include:

- Implementation of enclosure and facing of processing plants
- Installation of proper sound barriers system and/or noise containments, with enclosures and curtains at or near the source equipment
- Installation of natural barriers at facility borders like vegetation curtains or soil berms
- Optimization of internal-traffic routes,
- The most significant vibrations in mine are usually associated with blasting activities.
- Mines should minimize significant sources of ground vibration, such as through adequate design of crusher foundations. For minimizing blasting related emissions (vibration, air-blast, overpressure, or fly rock), the following management practices are recommended:
    - Mechanical ripping should be used, where possible, to avoid or minimize the use of explosives;
    - Use of specific blasting plans, correct charging procedures and blasting ratios, delayed/micro-delayed or electronic detonators, and specific in-situ blasting tests (the use of down-hole initiation with short-delay detonators improves fragmentation and reduces ground vibrations);
    - Development of blast design, including a blasting-surfaces survey, to avoid over confined charges, and a drill hole survey to check for deviation and consequent blasting recalculations;
    - Implementation of ground vibration and overpressure control with appropriate drilling grids; and
    - Adequately designing the foundations of primary crushers and other significant sources of vibrations.

The environmental management plan should include these measures as appropriate for the control of noise and vibrations.

8.4. Mitigation of Hazardous Materials and Chemicals

All mining projects involve the use of liquid petroleum fuels. Many mining operations commonly use of cyanide and the co-production of mercury. The Environmental management plan should include well-designed measures for preventing serious impacts that releases of cyanide, mercury, and petroleum fuels have on the environment.

1. Cyanide use - cyanide is strongly toxic to humans and wildlife. The use of large quantities of cyanide solutions is the common practice in mining operations for gold and copper ore concentration operations. Cyanide use should be consistent with the principles and international standards of practice. Additional problem with cyanide is that it mobilizes mercury as mercury cyanide complexes, and these concentrations can be very high in process fluids and ponds. Mercury should be measured on a regular interval and wildlife, workers, and surrounding residents protected from exposure to mercury, either in process fluids or from volatilization of mercury from tailings facilities and heap leach operations. Antimony and Arsenic are also usually observed in high pH process fluids and should be measured and reported on a monthly basis. The environmental management plan should incorporate a commitment that the mining company will use cyanide consistent with the principles and standards of practice.

2. Mercury - most gold mining companies and some mining companies involving other metals have potential for releasing mercury into the environment during ore processing. Mercury is produced as a byproduct of gold mines. As a result, more consistent and more mercury measurements should be required. Because of the complexity of the mercury emission sources, a systematic evaluation of the methods used to determine mercury emissions rates and concentrations should be undertaken. New systems for better mass balance are recommended for accurate assessments of mercury release. This includes more precise measurements of mercury in the ore, mercury in the process fluids, and mercury sent out to the tailings facilities. The amount of mercury in the ore should be accounted for in a life-cycle assessment.

The environmental management plan for any mining project that has the potential to generate mercury must include special measures for preventing the release of mercury to the environment. If the ore being mined contains significant trace amounts of mercury, then the plan should explain how mercury generated as a by-product of ore processing will be controlled to prevent mercury releases.

3. Storage of fuel and liquid substances - different chemical substances including corrosives, poisons, brines and hydrocarbons may escape from storage facilities through various mechanisms including:

- Lack of containment facilities;
- Poor construction quality or deterioration of containment facilities;
- Improper equipment maintenance operations;
- Poor management practices;
- Accidental damage and deliberate vandalism.

The leakage of tank contents to the environment may adversely impact the quality of water resources. To prevent these impacts, the following measures are recommended for the storage of fuel and liquid substances at mine sites.

- Tank site for above-ground storage facilities should not be constructed:
- In wellhead and reservoir protection zones within a Public Drinking Water Source Area;
- Seasonally inundated land unless backfill is placed to protect the tanks against flooding risk and the footings against erosion;
- Slood plains i.e., areas that may be affected by a 1-in-20 year flood;
- Within 30 meters of the bank of any seasonal water body or surface water drainage line; and within 100 meters of the bank of any permanent water body.
- All facilities should have a one-meter clearance between the finished ground surface and the historical maximum groundwater level.

The environmental management plan should include these measures for the storage of fuel and liquid substances.

8.5. Mitigations of Mine Impact on Wildlife

Mining operations significantly affect wildlife. The best measures for the protection of wildlife are those measures that prevent impacts to wildlife habitat. There is nothing that obliges a mining company to extract the full extent of the ore deposit. Mining projects should take care for protected areas or other critical or sensitive ecological areas, even if it means leaving some of the ore deposit in the ground. Mitigation measures, such as wildlife relocation projects, are rarely effective and the EMP should not assume that wildlife relocation projects would be practical.

For mining projects that generate significant toxic waste piles or impoundments of toxic waters, the environmental management plan should call for the use of barriers such as fences and netting, to prevent animals and birds from suffering exposures to toxic substances in mining wastes.

8.6. Mitigation Measures for Socio-economic

Mining operations significantly affects socio-economic activity in the project area. The mitigation measures to improve the socioeconomic impact from mining include the following:

- Strategic interventions and actions to empower women to benefit from the mining projects and to exercise their rights so that they are able to report any injustices to the authorities and seek legal redress,
- Capacity building training of local experts for better involvement in the mining works
- Protection of historical and cultural resources,
- Improving the existing local road and transportation system,
- Strengthen family values by counseling and encouraging mining workers to visit their families regularly and avoid cohabiting in the mines,
- Rehabilitation and refilling program of abandoned quarries or pits,
- Strengthen social values and provide security in the mining areas,
- Counseling and encourage HIV/AIDS victims to take retroviral drugs and observe healthy living to avoid further spread of the virus,
- Minimizing displacement or disruption of people's as much as possible, if not, people will be properly compensated as per legal requirements,
- Parallel increase in building of social facilities, houses, infrastructure, and services to cope with the increased population due to mining and minimize the stress on existing facilities,

- Awareness creation for workers and community to protect themselves from HIV/AIDS and other communicable diseases,
- Preparation of emergency response plans specifically applicable to project-specific risk and disasters,
- Provision and maintenance of necessary emergency response and rescue equipment,
- Sufficient number of first aid trained employees to respond to emergencies, and
- Training of selected community on disaster mitigation measures and emergency response plan.

8.7. Mitigation Measures for Climate Change

Mitigating and adapting to climate change are important issues for mining sector to manage:

- Limit their contribution to climate change by measuring, managing and working to minimize GHG emissions
- Increasing the adaptability of mine operators and the local area to the forecasted impacts of climate change,
- reducing environmental impacts on water and biodiversity and increasing benefits to local communities

8.8. Mitigation Measures for Ecosystem Services

The following major mitigation measures are recommended for ecosystem service for mining project:

- Prevent disturbance of habitats (plant and animals),
- Re-vegetation of plants species specific to the local area,
- Avoid mining expansion and exploitation if the ecosystem service values are higher than the benefit of mining,
- Reduce water pollution through good chemical management and watershed management
- In situ and ex situ conservation for indigenous medicinal plants,
- Prepare land use plan for optimized use of resources,
- Preparation of Alternative recreational botanical garden,
- Nursery establishment, and
- Reforestation.

8.9. Mitigation Measures for Disaster Risk

Some of the major mitigation measures for disaster risks are:

- Prepare contingency plan for disaster risks such as hurricanes, flooding, mudslides, earthquakes, tsunamis, volcanic activity
- Prepare plan and procedures for hazardous or toxic chemicals, leaching into groundwater, dam or impoundment breaches, etc.

8.10. Artisanal Mining Impact Mitigation Measures

- Establishing legal and institutional conditions,
- Provision of technical assistance,
- Introduce mining extension services,
- Establish authority structure in the mining site,
- Establishment of an incentive scheme to reduce damage on environment,
  - Providing picks, sluice boxes, etc.
- Promotion of artisanal miners to small scale mine cooperatives.

8.11. Decommissioning Phase and Closure

This part should briefly describe how the project will be decommissioned and closed. It should address the management of the potentially significant impacts identified in the impact identification section. The major mitigation measures recommended are:

- Infrastructure areas: demolition or disposal of structures and buildings, removal of foundations and debris and rehabilitation of the surface,
- Mine residue deposits including: disposal facilities (pipes, solution trenches, return water dams etc.); ongoing seepage; control of rainwater; and long-term stability,
- Final rehabilitation with respect to erosion and dust control,
- Sealing of underground workings and rehabilitation of dangerous excavations,
- Final rehabilitation of opencast mine haul ramps and roads, final voids,
- Maintenance: if aspects of the decommissioned site require maintenance up to the time that closure is approved, these should be described.

8.12. Summary of Enhancement and Mitigation Measures

For each potential adverse impact, there should be proposed mitigation measures at each stage (construction, operation, commissioning and closure) of the project for the identified adverse/negative impacts. The proposed cost for the management of mitigation measures should be assessed and described in detail. It is essential that these costs of mitigation be adequately assessed and be fully documented. This is very important in the selection of the preferred alternative. In the case of beneficial impacts, it should be demonstrated how these can be maximized. Summary of enhancement and mitigation measures for different mining phases are annexed (Annex IV).

The following table provides sample template to summarize environmental social management plan for mining project.

Table 1: Template for summarizing ESMP

Phases of the project	Potential Environmental Impact	Proposed mitigation measures and Enhancement measures	Schedule for implementation mitigation measure	Responsible institution	Cost Estimated
Physicochemical Environment					
Exploration					
Construction					
Operation					
Decommissioning					
Biological					
Exploration					
Construction					
Operation					
Decommissioning					
Ecosystem Services					
Exploration					
Construction					
Operation					
Decommissioning					
Climate Change					
Exploration					
Construction					
Operation					
Decommissioning					
Socio-Economic					
Exploration					
Construction					
Operation					
Decommissioning					

9. ENVIRONMENTAL AND SOCIAL MONITORING PLAN

9.1. Monitoring Measures

The scope of monitoring depends on the location and complexity of the operation and the severity of the potential impacts. Monitoring measures should address all phases of the mining proposal: exploration, construction, operations and decommissioning. ESIA sets out measures by which the mining company or responsible government officials will monitor the performance of the mining project and its impact on the environment. During mining operations, the monitoring program is part of the company's overall environmental management system, and should respond directly to the environmental issues identified in the ESIA performed before operations started. The program should show the work plan, responsibilities of the mine staff, monitoring arrangements and reporting systems. Monitoring programs start with baseline sampling programs performed to characterize the pre-development environment.

The monitoring plans should be designed to meet the following objectives:

- To demonstrate compliance with the approved exploration, operations, and reclamation and other national or local environmental laws and regulations,
- To provide early detection of potential problems, and
- To supply information that will assist in directing corrective actions should they become necessary, including after the mine is closed.

Information about the monitoring that will be carried out should be detailed to ensure it will be useful, timely and accurate. Monitoring can be detailed for specific mitigation measures or can be pulled together into an integrated "Monitoring Plan". Where applicable, commitments to conduct monitoring should include:

- Details on type and location of monitoring devices,
- Sampling parameters and frequency,
- Analytical methods and detection limits,
- Quality assurance and quality control procedures,
- Reporting procedures (to whom, how often, etc.),
- Who will conduct and pay for monitoring,
- Procedures to respond to adverse monitoring results, and

- Actionable levels, i.e. performance criteria that will be used to interpret and act upon the results of monitoring within a specified timeframe. For example, if contamination levels will be used to trigger the implementation of prevention/treatment and control measures, they should be specified along with the nature of expected follow-up action.

The plans for monitoring should also include the standards and criteria that should be met. Examples of monitoring programs which may be necessary include:

- Surface water and groundwater quality and quantity.
- Air quality,
- Revegetation success ,
- Stability,
- Vibration levels from blasting,
- Noise levels, and
- Wildlife mortality and other wildlife impacts.

Financial assurances should be provided to ensure adequate funds will be available to implement the monitoring plan and mitigate for detected problems both during and after the mining operations. Some problems may not show up for many years (e.g., groundwater contamination), so in some cases monitoring may need to be conducted for many years after mine closure. How long the funds are held can vary based on the type of operation and the modeling predictions. The need for a contingency fund for long- term mitigation measures should also be seriously considered if there is possibility for impacts such as acid rock drainage, which can last in perpetuity.

In particular, the Environmental Monitoring Plan (EMP) needs to give more than details about where, when, what, and how often a mining company will monitor the quality of the water, air, and soil in the mining project area, and the quantity of pollutants in effluents and emissions.

9.2. Water Quality

A proper water quality monitoring program can ensure whether mining company is satisfying promises in its Environmental Monitoring Plan. The water quality monitoring section of the ESIA should address the following.

i. **Surface water quality**

Monitoring for surface water quality to check chemical alteration or deterioration due to mine activity shall be conducted for the following:

- Discharge or seepage exiting on-site sources,
- Discharge or seepage exiting the property boundary,
- On-site water bodies and water bodies downstream from the site, and
- Background reference sites identified during baseline study.

Monitoring frequency should be sufficient to obtain representative data for the parameter being monitored.

ii. Groundwater quality monitoring

Monitoring is one of the most important aspects of protecting groundwater resources. This can be achieved by constructing a network of groundwater monitoring wells or boreholes. Assessing groundwater quality before mine operation commencement can set the environmental management needs of a project. Groundwater monitoring should be conducted during mine development and closure phases.

iii. Parameters used for water quality monitoring

Monitoring of water quality impacts from mining projects should incorporate analysis of the following parameters:

- pH;
- Conductivity;
- Total suspended solids;
- Total dissolved solids;
- BOD and COD
- Alkalinity;
- Acidity;
- Hardness;
- Cyanide;
- Ammonium;

- Sulphate;
- Nitrate;
- Aluminum (Al), arsenic (As), cadmium (Cd), calcium(Ca), copper (Cu); iron (Fe), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni) and zinc (Zn).

9.3. Air Quality

A mining project must have an air quality monitoring plan to record the emissions of the most significant air pollutants. The selection and location of monitoring equipment should comply with internationally acceptable standards based on technical assessments made during the baseline survey. The local weather conditions, topography, residential areas, and wildlife habitat help determine the best location of air quality monitoring equipment.

Key issues in ASIA with respect to air quality monitoring pan include:

- Does the ESIA have a detailed air quality monitoring plan?
- What methods and equipment are used?
- What are the criteria that were used to select the location of the monitoring points?
- How frequently will data be collected?
- Is an independent agency going to assess the calibration and implementation of the air quality monitoring plan?
- Will the results be available to the public?

9.4. Vegetation and Soil Quality

Key issues in vegetation and soil quality monitoring include:

- How would alterations of land be reported and which methods would be used to quantify the excavated and/or disturbed lands?
- How would surface erosion and disturbance to soils be recorded and reported?

9.5. Wildlife and Habitat

In monitoring the mining impacts on wildlife and habitat the key issues include:

- How are the effects on fauna, flora, and habitats going to be monitored?
- Is an independent agency going to assess the potential effects on terrestrial and aquatic wildlife and habitat?

- What methods would be used to organize and report the monitoring data?
- Is that information available to the public and local authorities?

1. Key Species

Mining operations cause activities that could significantly affect the natural functions of terrestrial and aquatic ecosystems. Due to this, an Environmental Monitoring Plan for a large-scale mining project would include periodic assessments of impacts on key wildlife species, with support from an independent group of qualified professionals. In this regard, the baseline section of the ESIA should identify wildlife species listed by local and/or national authorities and endemic species.

Main issues with respect to key species include:

- Evaluation of habitat loss,
- Key species should be previously identified in the baseline study,
- Conduct surveys to evaluate the reduction or alteration of key species populations, and
- Overview of change in the ecosystem and potential exposure of key species to hazardous pollutants.

2. Habitat Loss

An Environmental Monitoring Plan (EMP) must include plans to perform regular surveys to assess the state of the habitat. These plans must include the map of previously surveyed areas, to define in advance the scope of habitat monitoring.

Key issues in habitant monitoring plan include:

- Habitat types should have been adequately identified and mapped previously,
- Who will perform the habitat monitoring? This activity requires qualified independent experts,
- Surveys must determine habitat density changes in several locations, and
- Assessments of the current status of key species depend on field work (count and observed species, population densities).

9.6. Socio-economy

Mining projects can cause serious disruption in local communities, related to benefits and costs that may be unevenly shared. The economic benefits of a national or foreign mining corporation do not necessarily result in local development Environmental degradation significantly affects the livelihood of local people.

The main issues related with community and occupational health includes:

- Incidence of pollution related diseases and deaths,
- Assessment of water availability and quality for domestic use, agriculture, and other productive activities,
- Air quality assessments results in populated areas,
- Records of regular or episodes of high air pollution (check compliance with the local, national, or international guidelines and standards),
- Incidence of prostitution, alcoholism, and sexually transmitted diseases related to the presence of mining workers in the area.

Example of monitoring plan of mining activities is attached (Annex V). The following table provide sample template for summarizing environmental and social monitoring plan.

Table 2: Template for summarizing environmental and social monitoring plan

Phases of the project	**Mitigation Measures/Enhancement Measures**	**Parameters To be Monitored**	**Approaches to be followed to monitor each parameter**	**Frequency of measurement**	**Responsible institution**	**Cost Estimated**
Exploration						
Construction						
Operation						
Decommissioning						

ENVIRONMENTAL AND SOCIAL AUDITING

Mechanisms to ensure the commitments in the EIA document are followed including creating and certifying third-party auditors and defining their roles in the process. It is not sufficient to monitor compliance with commitments, and failure to meet commitments should be followed by enforcement for failure to comply in order to compel actions needed to protect environmental, socioeconomic and cultural interests. For this system to work, commitments in the EIA should be written in a manner that clearly provides the basis for an independent audit and also clarity for the project proponent to ensure it is clear what they will be undertaking and when.

EIA procedural guideline series-1 (EPA, 2003) indicates that Environmental Assessment (EA) audits are conducted at various stages in ESIA process. It indicates that environmental and social audit is expected at the corresponding levels in project cycles and a step wise approval shall be done. The environmental and social audit is expected to be made in two or three years at minimum period to evaluate implementations of the recommended environmental and social mitigation measures indicated in the environmental and social management plan of the project.

Environmental audit process is usually categorized into three stages; pre-audit activities, onsite audit activities and post audit reporting (EPA, 2006). Each of these steps are discussed in the following sections.

10.1. Pre-audit activities

The pre-audit activities of and environmental and social audit is planning of the audit itself. Planning is fundamental to the success and it is vital in having clear idea of what is to be achieved, how the audit is conducted and what the follow-up mechanism will be in minimizing time spent on audit activities and prepare audit team in operating at maximum productivity throughout the audit program.

10.2. On site Audit Activities

The execution of the audit in the industrial enterprises (i.e. onsite) involves among others an opening meeting, site tour/inspection, collection of information/evidence, evaluation and verifications, team meetings, preparation of findings and a close out meeting.

10.3. Post Audit Reporting

The final stage of the audit involves producing an audit report in which the audit findings, conclusions and recommendations are presented. The wording of the findings should not deviate from those agreed upon in the closing meeting. The lead auditor is responsible for the preparation, accuracy and completeness of the audit report.

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ANNEXES

Annex I. ESIA Report Outline

1. Executive Summary;
2. Introduction including goals, scope, objectives and methodology;
3. Policy, Legal and Administrative Framework;
4. Project description (activities, process, input materials and chemicals, mining method and etc.)
5. Description of baseline environment and social setting of mining project area;
6. Description, predication and analysis of potential environmental and social impacts of the project;
7. Analysis of project alternatives;
8. Impact enhancement, mitigation, management, closure and rehabilitation plan;
9. Monitoring plan;
10. Public consultation processes and findings;
11. Conclusion and recommendations;
12. List of References;
13. Appendices:
    i. Photographs, term of reference, consulting team composition, Note of public consultation sessions.
    ii. Checklists and standards and other supporting documents.

Annex II. Summary of Beneficial Impacts of Mining Project

Environmental Attribute	Positive Impacts
1. Land use	- Land reclamation/restoration of mined out lands may give rise to beneficial land uses e.g. recreation, agriculture, etc.
2. Landscape	- Landscape Reclamation/restoration may create better land use and landscape with considerations for environmental management
3. Forest	- Ethiopians construct most of their houses from wood and mud. Modernization coupled with the extraction of locally available construction materials and industrial products such as cement help to shift from mud-house to stone-houses. - This endeavor boost the efforts made in minimizing the deforestation.
4. Socio-economic	- Increased individual incomes - Direct employment at the mine - Increased purchases from local businesses - Other economic activities stimulated in the community as a result of the mine - Employment opportunities (short- and long- term for local residents) - Workers need to be trained and provided with health and safety equipment - Increased tax base - Resource royalties - Opportunity for a community development agreement with the mining company
5. Ecosystem	- Restoration may improve ecosystem
6. Public health & safety	- Health care amenities

Annex III. Summary of Mitigation Measures for Mining Exploration Phase

Main Activities	Impacts	Affected Environmental Components	Mitigation Measures	Remarks
Use of field trucks for geological mapping and sampling	- Negligible amounts of emissions, - Dust and noise from vehicles. - Slight disturbance to vegetation and wildlife,	- Vegetation, - Wildlife - water	- Avoid disturbance of wildlife and vegetation during truck paths - Erosion and Sedimentation control measures	This impacts expected to be negligible to small , but should be acknowledged in the ESIA
Seismic lines, and aircraft strips	- Negligible amounts of emissions, - Minor Dust and noise from helicopters and vehicles. - Slight disturbance to vegetation and wildlife,	- Vegetation, - Wildlife and - water	- Avoid disturbance of wildlife during helicopter & truck paths - Minimize vegetation clearing along seismic lines - Erosion and Sedimentation control measures	This impacts expected to be negligible to small , but should be acknowledged in the ESIA
Digging, Pitting, trenching, excavation and quarrying	- Habitat disruption; - Noise pollution, - Landscape distraction - Erosion and sedimentation	- Vegetation, - Wildlife and - Water - Air quality	- Protection of wildlife species - Dust, Erosion and sedimentation controls - Refilling excavations	
Drilling for sample collection	- Exhaust emissions, dust, and noise. - Disturbance to vegetation and wildlife. - Possible impacts to water associated with drilling fluids and mud disposal.	- Vegetation, - Wildlife and - Water - Air quality	- Protection of wildlife species - Dust control measures - Treatment/disposal of mud and fluid - Management of drilling fluids. Drill hole plugging.	
Blasting/use of explosives	Noise and vibration levels associated with blasting.	Noise and Vibration	Restricted hours of operation of heavy equipment and blasting if exploration is in a populated area and seismic monitoring.	
Workshop and labor camp activities	Camp sites impact due to production of solid and liquid wastes, used engine oil, packing garbage	Water	Sewage treatment, liquid and solid waste management at workshop and labor camps	

Annex IV. Impact and Mitigation Measures at Construction, Operation and Decommissioning Phase

Affected Environmental components	Main Activities	Phases			Mitigation Measures
		CP	OP	DP	
Air Quality	Pollution formed during: - Drilling	X	X	-	- Minimize land clearing, topsoil removal and stacking, - Dust emissions control during blasting , processing and transportation - Re-vegetation - Use appropriate technologies and methods - Reduce greenhouse gas emissions and pollutants such as CO, CO_2, NOx, SOx, and VOC.
	- Blasting	X	X	-	
	- Loading and unloading	X	X	X	
	- Transportation	X	X	X	
	- Traffic movement	X	X	X	
	- Excavation of overburden and dumping	X	X		
	- Backfilling		X	X	
	- site clearing,	X	X		
	- crushing,		X		
	- grinding,		X		
	- access road construction	X	X		
	Gas emissions from ore processing, machineries and equipment, etc.	X	X	X	
Water Quality	Erosion of sediments and deposition in surface water	X	X		• Construction of sedimentation ponds • Disposal areas for excess excavation materials will be sited in approved areas to control erosion and minimize leaching of hazardous materials. • Catch basins, drainage ditches, and culverts will be cleaned and maintained regularly • Preventing sulfides in wastes and exposed geological materials from being converted to sulfuric acid. • Due to the treatment of AMD takes long period of time ESIA should emphasize mitigation measures that prevent acid mine drainage from ever starting. • proper placement of soil and rock piles to reduce exposure of sediment generating materials to water or wind • Divert surface runoff from undisturbed areas toward the disturbed areas • management of waste rock dumps for the protection of water quality.
	During operation sulfide minerals are exposed to weathering and react with water and oxygen to produce acidic solutions		X		
	The acid leaches release heavy metals like lead, zinc, copper, arsenic, selenium, mercury and cadmium		X		
	contamination of surrounding water resources with acids, dissolved metals, metalloids and other contaminants		X	X	
	Failure of tailing impoundments/dams and leakage or spilling of contaminant into surface water		X	X	
	Pumping and discharging mine water to the environment		X		
	Use of ground and surface water for mining		X		
	pollution from domestic and sewage effluents; etc	X	X		
Noise and Vibration	Generation of obnoxious levels of noise and vibrations;	X	X		Control of noise and vibrations through different mechanisms like; Limit noisy activities, Provision of PPE for employees, Notify nearby residents in advance when blasting or other noisy activities are required and the like.
	occupational health hazards;	X	X		
	damage to structures;	X	X	X	
	disruption of wildlife, etc	X	X		

Soil Quality	The soil loses its stability and easily prone to wind and water erosion due to; - vegetation clearance	X	X		• Design runoff control features to minimize soil erosion. • Use special construction techniques in areas of steep slopes, erodible soils, and stream crossings. • Save topsoil removed at the start of the project and use it to reclaim disturbed areas upon completion of mining activities. • Restore or apply protective covering on disturbed soils as quickly a possible. • Apply erosion controls to reduce soil erosion from vehicular traffic and other mining activities • Stabilize all areas of disturbed soil using weed- free native shrubs, grasses, and forbs
	- disturbance of soil layers by excavation activities	X	X		
	- Mining on slopes		X		
Ecosystem	The contamination of mining area environmental components can impact terrestrial, aquatic, and wetland ecosystems				Mining projects should take care for • protected areas or other critical or sensitive ecological areas • instruct employees and contractors disturbance of Wildlife, ecologic, vegetation and other ecosystems • fences and netting, to prevent animals and birds from suffering exposures to toxic substances in mining wastes • Re-vegetation of indigenous and other appropriate trees, etc.
	- Loss of habitat;		X	X	
	- Loss of biodiversity; flora & fauna; fisheries;	X	X	X	
	- migration of species;	X	X		
	- Overall disruption to the ecosystem and ecosystem services of the area.	X	X		
Land Use	Existing land uses in the area that may be affected by mining include but not limited to: - Parks - Wildlife refuges - Forest reserves - Hunting areas - Farm lands - Grazing land - Utility corridors - Roads - Human settlements - Etc.	X	X		• Implement a restoration plan. • Compensate farmers for property losses and restore lost agricultural lands at the end of the project. • Compensate property owners for relocation if, the relocation is unavoidable. • Make maximum level to design to reduce or avoid unacceptable surface impacts caused by subsidence, etc.
Landscape Change	- Visuals (unsightly dumps, mine structures, voids, subsidence, mine fires, etc.; change in land forms and associated impacts- soil erosion, loss of top soil, change in complete geology, etc.	X	X	X	• Rehabilitate the environment up on departure. • Refill the excavated ground with preserved soil. • Replanting and maintain vegetation to restore the natural appearance of the area, etc.
Climate Change	- Deforestation due to the development of mining projects also cause an increase in GHG emissions	X	X		• Mitigating and adapting to climate change are important issues for mining sector to manage

	- Coal mining is both energy intensive during extraction and emits large amounts of GHGs during its use leading to increased climate change impacts.		X		• Limit their contribution to climate change by measuring, managing and working to minimize GHG emissions • Increasing the adaptability of mine operators and the local area to the forecasted impacts of climate change, • reducing environmental impacts on water and biodiversity and increasing benefits to local communities
	- Emissions from fuel use in mining and processing, transportation, fugitive emissions, from refining and smelting		X		
Liquid and solid wastes	- The solid wastes from mining are waste rock and tailings that are principally impacts to surface and groundwater, and possibly to air.	X	X	X	• Treatment plant shall be provided • Treatment effluent shall be used for dust suppression and plantation/ green belt development • Periodic monitoring of waste water to be discharged • Properly dumping, etc. •
	- Liquid wastes from sewerage, camps, work shop, garages, drilling machine etc	X	X		
Socio-Economic	- Displacement and relocation of current residents/ resources	X			• Minimize household/resource relocation as much as possible, if not, • People will be properly compensated as per legal requirements
	- Displacement or disruption of people's livelihoods (e.g., fishing, hunting, grazing, farming, forestry)	X	X		
	- Strain on existing houses, infrastructure, and services as a result of increased population	X	X		
	- Public finance requirements – more infrastructure may need to be built and maintained to meet the demands of increased population for public education and public services (water, sanitation, roads, etc.)		X		
	- Increased traffic and truck trips (safety, noise, exhaust)	X	X		
	- Reduction in quality of life for residents from visual and noise impacts	X	X		
	- Increased crime and illicit activities (drugs, alcohol, gambling, prostitution, etc.)	X	X		
	- Creation of a mining camp may breakup family units, disrupt culture & social relations, etc		X		
Public Health and Safety	- Respiratory & water borne diseases due to dust and pollution of water bodies;				- Awareness creation for workers and community to protect themselves

	- safety due to blasting &explosions				from HIV/AIDS and other communicable diseases. - Provision of PPE - Preparation of emergency response plans specifically applicable to specific project, - Provision and maintenance of necessary emergency response and rescue equipment; - Sufficient number of first aid trained employees to respond to emergencies. - Implementation of specific personnel training on worksite health and safety management including a communication program with a clear message about corporate management's commitment to health and safety
	- Spread of communicable diseases particularly of HIV/AIDS due to the influx of more people to the area				
	- Solid, liquid and hazardous waste also pose hazards to Health and Safety				
	- Natural hazards working in extreme temperatures and flash flooding				
	- Dangerous wildlife such as poisonous snakes.				
Cultural and historical resources	Impacts of cultural or historical resources in and around the mine may include but not limited to;				
	- Archeological sites				
	- Historic buildings				
	- Burial grounds				
	- Sacred or ceremonial sites				
	- Sites used for the collection of materials used in ceremonies or traditional lifestyles				
	- Sites that are important because of their roles in traditional stories				
Decommissioning	- Contamination of land, soil associated with vehicle and equipment operations and maintenance, - risk of subsidence from underground mines, - on- site facilities and equipment that are no longer needed, - waste from demolishing of building				• Protection of open pit from contamination of hazardous from vehicles equipment and maintenance. • Backfilling of underground voids to limit risk of subsidence from occurring, • Closing open pits, backfilling or installing fencing and berms, to prevent unauthorized access and to protect public safety, • Control the discharge of water and flow rates from mining activities to the receiving water body to protect water pollutions by pollutants, • Rehabilitation of roads, runways or railways , so can restored natural stream flow, and stabilized stream banks with vegetation or by using rip- rap. • Rehabilitation of roads, runways or railways, so can restored natural stream flow, and stabilized stream

					banks with vegetation or by using rip- rap. • Rehabilitated surfaces, shoulders, escarpments, steep slopes, regular and irregular benches to prevent erosion. • Safely and appropriately dispose or store wastes from the demolition of buildings and the removal of equipment in appropriate waste disposal sites and manner in accordance with relevant regulatory requirements
Risks from Natural Disasters	- Cause by natural phenomena or climate change impacts				Prepare contingency plan for disaster risks such as Hurricanes Flooding, Mudslides, Seismic activity, earthquakes, Tsunamis, Volcanic Activity
Other risks	- Risk may happen coincidence or unexpected reason				Prepare plan and procedures for hazardous or toxic chemicals, leaching into groundwater, dam or impoundment breaches etc.
Ecosystem Service		X	X	X	- Prevent disturbance of habitats (plant and animals), - Re-vegetation of plants species specific to the local area, - Avoid mining expansion and exploitation if the ecosystem service values are higher than the benefit of mining
Restoration	- Impacts accumulated from exploration and mining activities	X	X	X	• Stabilization of surface area or top soil to control erosion and air pollution. • Contouring of waste rock piles, tailings, leach pads, and borrow pits; • Establishment of a final drainage system; • The establishment of wet covers or dry covers, where these cover systems to prevent or control acidic drainage; • Re-vegetation of exposed areas following backfilling; • Progressive restoration of roads (no longer use) drill pads or campsites established during exploration, operation or construction phases. • Backfilling, grading, topsoil replacement, and re-vegetation of disturbed land. • Stabilize potential landslide area to prevent slide and erosion.

Annex IV. Examples of Monitoring Plan of Mining Activities

Type of Mining Activities	Components to monitor		Monitoring Activity by performance indicators
1. Exploration Restoration of roads drill pads, test pits, tunnel sites and labor camps: (Use of heavy equipment to reclaim sites.)	Vegetation		Re-vegetation of disturbed areas
	Wildlife		Restoration of disturbed habitats.
	Surface Water		Concentration of acid and metals waste from discharge waters.
	Groundwater		Level of contamination of groundwater infiltration.
2. Mining			
	Surface water and groundwater quality and quantity	Sediment and Erosion	Restoration of all disturbed or destroyed habitat aquatic/riparian/wetland habitat and disturbed soil, The quality and quantity of water effluent discharged to the environment is to the standards specified by the Authority, Contaminant concentrations of surface water in excess of water quality standards specified by authority, The concentration of pesticides used for the project will meet international standards for non - persistent, immobile pesticides. Minimum contaminate in aquifer recharge areas, Stabilization of slope and stream crossing, Minimum erosion rate and leaching of hazardous material.
		Surface and ground water quantity	Monitor reduction in the flow of a stream or spring below the designated threshold flow as a result of mining operations. Minimum flow requirements for streams and springs necessary to sustain a healthy aquatic and riparian environment for each of these water bodies. Groundwater water table elevation decrease
		Surface and ground water quality	Monitor storm water quality or contamination by acid/heavy metals/other toxins, Monitor the level of contaminants filtered from the water.
		Acid Rock Drainage, tailings and leachate	Monitor contamination of groundwater or surface water from the project facilities not exceed any water quality standard specified by the ministry office manuals. Monitor contaminant prevention methods are effective and that affected water has been fully captured and controlled
	Air quality	Dust	Reduction of airborne emissions such as dusts, particulate matters and. should be monitored and reported, And Develop a long- term monitoring program that ensures the proposed mitigation measures in section of mitigation are implemented properly.
		Greenhouse gases	Reduction of greenhouse gas emissions and pollutants such as CO, CO2, NOx, SOx, and

			VOC and heavy metals
	Vegetation		Revegetation of disturbed areas
	Soils		Restore or apply protective covering on disturbed soils Erosion controls measures to reduce soil erosion such as Jute netting, silt fences, and check dams, Stabilization of areas of disturbed soil using weed- free native shrubs, grasses, and forbs.
	Geology		Reestablish the original grade and drainage pattern to the extent practicable, Backfill or recontour strip- mined or contour-mined areas, any foundations, and trenches, preferably with excess excavation material, control erosion and minimize leaching of hazardous materials, Stabilization of unstablee slope
	Noise		Level of noise in the surrounding residences and sensitive receptors
	Cultural and Historic		Loss of cultural resources or recovery of the loss
	Wildlife		Restoration of disturbed habitats for wild life.
	Ecology and vegetation		Level and frequency of accidental contamination of habitats. Soil stabilization and erosion reduction, Re-vegetation and restoration of types and densities of species (with a preference towards native species) and disturbed area, Minimum or controlled noxious weeds and invasive plant, Reforest riparian zones with species appropriate to the native habitats and species. Re-establish or maintain functional wildlife corridors.
	Land Use		Compensate farmers and ranchers for crop or forage losses and restore lost agricultural lands at the end of the project, Compensate property owners for relocation of their homes , Restoration of land due to subsidence
	Visual		Restoration of ground disturbance and control erosion
	Hazardous Materials		spill prevention and response plan for storage, use and transfer of fuel and hazardous materials, Avoid contaminated in storm water or lower level of soil erosion.
	Health and Safety		All of the safety issues identified in the assessment and all applicable safety standards set forth by local governments and the relevant mine, safety and health administration.
	Socio-economy		
	Disaster Risk on		Monitor potential natural hazards such as landslides, slumps, debris flows, earth flows, mass wasting,

			Monitor potential Seismic hazard and Volcanic hazards
	Ecosystem Services		Rehabilitation and restoration of sensitive ecosystem services, water sources, timbers, food, medicinal values, Restoration of habitats (plant and animals)
	Climate changes		Reduction of greenhouse gas emissions and pollutants such as CO, CO2, NOx, SOx, and VOC from mining activities,
3. Decommissioning			Remediated open pit hazardous contamination
4. Restoration			Monitoring of Restoration activities includes: • Establishment of contouring of waste rock piles, tailings, leach pads, and borrow pits; • The establishment of a final drainage system; • The establishment of wet covers or dry covers, where these cover systems are to be used to prevent or control acidic drainage; • re-vegetation of exposed areas;

ANNEX VI. Base Metal and Iron Ore Mining

Limit Values for Discharges to Water

Parameter	Limit Value
Temperature	40 °C
pH	6 – 9
BOD_5 at 20□C	25 mg/l
COD	150 mg/l
Suspended solids	50 mg/l
Mineral oils	20 mg/l
Cadmium (as Cd)	0.5 mg/l
Mercury (as Hg)	0.01 mg/l
Arsenic (as As)	0.25 mg/l
Cyanide (as CN)	1 mg/l
Iron (as Fe)	5 mg/l
Lead (ad Pb)	0.5 mg/l
Zinc (as Zn)	3 mg/l
Copper (as Cu)	2 mg/l
Nickel (as Ni)	2 mg/l
Chromium (as Cr VI)	0.1 mg/l
Chromium (as total Cr)	1 mg/l
Total metals	15 mg/l

ANNEX VII. Limit Values for Emissions to Air

Parameter	Limit value
Particulate matter	50 mg/l
Silica	15 mg/l
SO_2 (mg/Nm^3)	1000 mg/l
Nickel (as Ni)	5 mg/l
Iron (as Fe)	10 mg/l
Copper (as Cu)	20 mg/l
Sulphuric acid (as H_2SO_4)	50 mg/l
Nitric acid (as HNO_3)	50 mg/l
Ammonia (as NH_3)	300 mg/l
Arsine	5 mg/l
Dioxins as International Toxicity Equivalent (I-TEQ)	1 ng/Nm^3

ANNEX VIII. Noise Standards to be Applied Where People Live or Work

		Limits in dB (A) Leq	
Area Code	**Category of area**	**Day time[1]**	**Night time[2]**
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45

1: Day time reckoned to be between 6.00 am to 9.00p.m

2: Night time reckoned to be between 9.00p.m. to 6.00am

ANNEX IX: Noise Standards for Motor Vehicles

Vehicle Type	Maximum Permissible Noise Levels, dB(A) at 7.5 metres from the source
Two wheelers (petrol-driven)	80
Three wheelers, all petrol-driven passenger cars and two wheeler diesel driven cars.	82
Passenger or light commercial vehicles fitted with diesel engine with gross vehicle weight up to 4000 Kg.	85
Passenger or commercial vehicles with gross vehicle weight above 4000 Kg and up to 12000 Kg.	89
Passenger or commercial vehicles with gross vehicle weight above 12000 Kg.	91

ANNEX X. Environmental and Social impacts monitoring plan format

Expected impacts	exp	CP	OP	DP	Detail of impacts	Proposed Enhancement measures	Monitoring objective	Parameters to be Monitored (Indicators)	Location	Measurements (Incl. methods & equipment)	Frequency of Measurement	Responsibilities (Incl. review and reporting)	Cost Estimates
Beneficial impacts……													
Adverse impacts ……													

Exp - Exploration phase

CP - Construction phase

OP - operational phase

DP – decomissioning phase

Annex XI. Artisanal Environmental Management plan checklist.

Site assessment – Artisanal Mining

Date of assessment……. Assessed by (miner, authority, other):…….

Table 3: Mine site

Location Coordinates Village Region Site name
Nearest responsible authority (locality, zone(small unit), kebele, district, zone, region)
Owner(s)
Pre mine inspection yes/no
Active mine yes/no
Opened date
Closed date
Mine details Pits Shafts Tunnels Dredges other
Plant/Mining techniques Panning Sluices Crusher Mills machines Others
Minerals
Estimated production
Permits
No. miners Male Female Children

Photos of site, see attached

Table 4: Environmental setting

Topography Hill Valley Plateau
Watercourses, water bodies, wetlands Names, size and distance to
Land cover Forest Grassland Farmland Shrubs Desert
Land use, type and distance to: Farmland Habitation Grazing Other

Photos of environmental setting, see attached:

Table 5. Environmental impacts

Area directly impacted by mining m X m
Area deforested **Area partly deforested**
Area indirectly impacted How is this impact?
Waste piles Material type Size
Pits Open Closed
Polluted water Flowing Stagnant Colour Amounts pH Samples
Mercury yes/no
Cyanide yes/no
Noise
Dust
Distance to water use, drinking water fishing washing, livestock bathing

Photos of impacts see attached

Table 6 Environmental management

Fences Signs
Settling ponds Collection drains Water treatment
Waste collection
Closed pits Closed shafts
Profiled dumps
Trees planted
Other vegetation established
Pre-mining activities
Post mining activities
Other business or industry on site
Cost allocated for environmental management

Photos of installations, see attached

Table 7: Dissemination of information Authorities informed about activities and possible hazards to people or environment

When where they informed and by who?
Mining bureau/office
Environmental protection authority
Education bureau/office
Agriculture bureau/office
Association/Micro enterprise
Local or kebele adminstration