INTOSAI
Working Group
on Environmental
Auditing

Auditing Mining:

Guidance for Supreme Audit Institutions

2010

This publication was prepared by the INTOSAI Working Group on Environmental Auditing (WGEA). The WGEA aims to encourage the use of audit mandates and audit methods in the field of environmental protection and sustainable development by Supreme Audit Institutions (SAIs). The WGEA has the mandate to

- help SAIs gain a better understanding of environmental auditing issues,
- facilitate exchange of information and experiences among SAIs, and
- publish guidelines and other informative materials.

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Foreword and Acknowledgements

In the 11th Working group meeting of WGEA in Arusha Tanzania in 2007; members of the International Organization of Supreme Audit Institutions Working Group on Environmental Auditing (INTOSAI WGEA) approved the 2008–10 work plan. In this work plan management of natural resources became one of the central themes of the INTOSAI WGEA.

This formulation of the theme was motivated by the fact that many countries are facing the challenge on environmental restoration due to the improper or unsustainable exploitation of natural resources, such as forests, minerals, and fisheries, these activities resulted into significant environmental degradation, social disruption and economic loss. Adoption of best management practices and effective government oversight of natural resource development is therefore important.

Mining has not been one of the most audited subjects among Supreme Audit Institutions (SAIs). The main objective of the guide is to encourage Supreme Audit Institutions (SAIs) to conduct audit on mining and mineral related activities. We do hope that this guide provides the reader with essential key questions and information needed to audit in this field. Information provided in this guide is based on numerous bibliographies and the document is designed to be used as a reference book.

Auditing Mining: Guidance for Supreme Audit Institutions is a resource for audit practitioners. It describes

- what mining means, why it is important, what are the threats caused by mining activities, and what actions can be taken by governments,
- a suggested process for choosing and designing audits of mining and minerals, and
- practical guidance, information, and case studies related to audits on mining and minerals.

This document was led by the SAI of Tanzania in particular, we would like to thank the authors Michael Malabeja and Robert Cheyo (Project Managers) and George Haule for their hard and excellent work in preparing the document. Many thanks go also to the numerous other organizations and individuals who contributed to this document, including the Ardhi University and the National Environmental Managemement Council (NEMC) for reviewing this document. Similarly, we would like to acknowledge the contributions made by the SAIs worldwide, especially those in the project sub-committee: the SAIs of China, Ethiopia, Mongolia and Uganda, and special thanks to the INTOSAI WGEA Steering Committee for their valuable help in various stages of the project and to the SAI of New Zealand for its editing support.

Readers are invited and encouraged to consult this document as well as information on other WGEA products and services on the INTOSAI WGEA website www.environmental-auditing.org.

We hope you will find this guide useful.

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Acronyms and Abbreviations

ASM - Artisans and small-scale mining

BLM - Bureau of Land Management

CFC - Chlorofluorocarbon

DSD - Division for Sustainable Development

EA - Environmental Assessment

EIA - Environmental Impact Assessment

EMA - Environmental Management Accounting

EMAS - European Eco-Management and Audit Scheme

GAO - General Accounting Office

ICME - International Council on Metals and Environment

INTOSAI - International Organization of Supreme Audit Institutions

ILO - International Labor Organization

ISO - International Organization for Standardization

LRTP - Long-range transboundary pollution

LVGF - Lake Victoria Gold Field

MMSD - Mining, Minerals and Sustainable Development

NGOs - Non Governmental Organizations

OAG - Office of the Auditor General

OECD - Organisation for Economic Co-operation and Development

SAI - Supreme Audit Institution

SEA - Strategic Environmental Assessment

SO_2 - Sulphur dioxide

UN - United Nations

UNCED - United Nations Conference on Environment and Development

UNCTAD - United Nations Conference on Trade and Development

UNEP - United Nations Environment Programme

WGEA - Working Group on Environmental Auditing

WHO - World Health Organization

WSSD - World Summit on Sustainable Development

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Executive Summary

A country's socio-economic development largely depends on the extent and composition of its natural resources. Examples of natural resources include forestry, minerals, and commercial sources of energy (like coal, oil, natural gas, and hydro power). Mining and mineral processing are activities for extraction and processing minerals for commercial use.

The mining sector is likely to contribute to the development of the economy of any country through taxes from large-scale mining companies, and contribute to social–economic infrastructural development within the area where the mine is located. The mining sector can:

- create employment opportunities both directly in the mines and indirectly on services to the mines,
- provide education and health services,
- increase foreign exchange reserves (reducing a country's foreign exchange deficit),
- improve infrastructure like roads and water supply, and
- create other economic activities to support the mines Instead of importing all supplies from abroad.

In developing countries, mining is a key sector and continues to grow. Legislation for mining may require an environmental impact assessment to be carried out before a mine is developed, and that a mine be developed and operated in an environmentally sound manner with the least impact on the environment. SAIs can undertake audits to check that the mining industry is complying with requirements of this kind. A SAI can therefore play a major role in auditing a government's commitment to protecting the environment from the negative impacts of mining.

Environmental aspects of mining

Despite the economic importance of the mining industry, there are serious environmental effects associated with it. The effects start at the exploration stage, extend through the extraction and processing of minerals, and continue after the mine has closed. The type and extent of the effects can vary from one stage to another. This guide provides an introduction to the environmental issues associated with mining activities, the relevant context where a SAI might be involved in auditing mining projects, and discusses the extent to which environmental issues should be addressed by private or public sector developers. The guide also briefly mentions certain associated social impacts and issues.

The environmental audit criteria

An environmental audit is a systematic, documented, periodic and objective evaluation of how well environmental regulatory requirements and commitments are met. The challenge to the auditor normally is selecting and determining the scope of the audit. This was the reason for designing a guide that will help SAIs and auditors when they choose and design audits on environmental impacts of mining. The guide presents various ways of describing the scope, from ownership and access rights for exploratory purposes through mining and processing, use of the end product and disposal of waste materials. Additionally, the guide presents the responses of governments, such as laws regulating mining and mineral activities, conventions, protocols, declarations, treaties, standards, codes and recommendations related to mining and the environment.

In conducting an audit of an environmental problem, four basic steps are essential. The four steps are:

Step 1: Identification of the environmental threats of mining in your country

Step 2: Identification of the government's responses to these threats

Step 3: Choice of audit topics and priorities

Step 4: Deciding on audit approaches (scoping the audit).

These steps are described in Chapter 3, and are used to define the objectives, scope, and criteria of an audit of mining. During the planning stage, the environmental problem(s) and responses in mitigating the negative consequences are identified. Further, auditors need to prioritise and limit the audit area.

The audit criteria are normally drawn from international conventions, legislation, policies, and programs.

Case studies of audits on mining activities

For each topic, auditors will develop audit criteria using experiences from similar audits conducted in other countries. Chapter 4 of this guide contains 8 audit case studies from around the world. The main objective of having audit cases on mining and mineral processing is to assist SAIs to make informed planning decisions on the envisaged audits by learning from the experience of other SAIs. Whenever possible, the experiences used from other countries will include information on audit objectives, scope, findings, and recommendations.

Encouraging mining audits

The INTOSAI Working Group on Environmental Auditing (WGEA) recommends that SAIs give attention to mining issues in their audit work. The Working Group also recommends that SAIs make use of the experiences on mining audits of their sister organizations within INTOSAI.

Through the environmental audits, SAIs will be able to raise awareness about the relevance of mining problems in their country and improve the programs of governments to solve these problems.

Scope of this guide

This guide does not include mining of oil and gas. Although much of the discussion also pertains to those parts of the mining sector, oil and gas are excluded from this guide due to their distinctive characteristics. The Steering Committee of the INTOSAI WGEA agreed that because of their distinctive characteristics of mining of oil and gas, the new audit guideline for auditing mining of oil and gas can be developed in the future.

Introduction

The main objective of this guide is to increase SAIs' knowledge and awareness about auditing mining by surveying different approaches to the problem and to inspire more audits in this field. The guide is intended to make it easier to start an audit about mining and encourage SAIs, with or without prior experience, to audit various aspects of environmental-related impacts due to mining in your country. The guide contains a large selection of problem areas that can be focused on, and it is our hope that it will induce auditors to approach the audit of mining from new angles, and to prompt many countries that have yet to do mining audits to get started in this important field.

This guide will help SAIs audit mining activities by

- educating auditors on the nature of mining activities, their potential impacts on the environment;
- describing the major role SAIs can play in auditing the actions of their governments and reminding them of their commitments,
- providing a four step approach to help auditors to plan and conduct an audit of mining in their country; and
- Presenting case studies that will help SAIs learn how others have approached this audit topic.

The minerals and mining sector

The mining and minerals sector is central to modern life in any country. Literally millions of products are constructed using a range of more than 90 mined substances from around the globe. Mining is likely to contribute to the development of the economy of any country, through taxes from large-scale mining companies that contribute to socio–economic infrastructural development within the area where the mine is located; creating employment opportunities both directly in the mines and indirectly through services to the mines; improving human capital through the provision of education and health services; increasing foreign exchange reserves (reducing foreign exchange deficit); improving infrastructure like roads and water supply; and creating other economic activities to support the mines instead of importing all supplies from abroad.

On the other hand, the supply of metals and minerals is not without environmental and social costs. The effects of mining continue long even after the mine has stopped operating. Poor mining and mineral processing practices can poison the air, land and water and then leave the environment to suffer a slow death. Many rivers have been pronounced "biologically dead" due to release of mine tailings (waste from the mine containing rocks, metals and poisons) into lakes and waterways. Aquatic plant and animal life are choked with toxic sediment.

Overview of environmental aspects of mining

The environmental effects of mining start with exploration, extend through the extraction and processing of minerals, and can continue after the mine closes. The nature and extent of effects can vary throughout the stages of project implementation. Both large and small-scale mining operations have an impact on the environment. Mineral resource activities affect all environmental media – land, air, water, and associated flora and fauna – as well as the human environment – individual health and safety, local community lifestyles, cultural survival, social order and economic well-being.

Although the majority of the impacts of mining are said to be "localized", mining can cause national, transboundary and global environmental problems. Environmental hazards and impacts also threaten indigenous cultures and native community land use, and socio-economic and cultural practices in countries with resource-based economies. These disruptions include permanent loss of natural resources, pre-emption of alternative land uses (for agriculture, forestry, hunting or leisure), ecosystem degradation and loss, destruction of key flora and fauna, displacement of populations, settlement influxes, crime and diversion of individuals and communities from traditional practices to boom-bust employment and small-scale or artisanal mining dependence.

The role of SAIs in auditing the mining sector

SAIs have a role to play regarding mining activities in their country. Among the roles SAIs can play is to facilitate the transparency of government operations and ensuring that an informed public guides the actions of governments in the mining sector. SAIs can promote sound financial management and public accountability – both of which are essential elements of sustainable development. Moreover, SAIs' independence in carrying out financial, compliance, and performance or value-for-money audits puts them in a unique position to legitimately and credibly evaluate the effectiveness and efficiency of government policy and obligations, and to report on any unsustainable mining practices.

Additionally, the outcomes of an audit on mining will result in improved institutional and stakeholder capacity in the mining sector in the country. Through the recommendations in environmental audit reports, the government (through its ministries, agencies or authorities dealing with mining) will want to ensure that mining companies take an environmentally and socially responsible approach.

In mining activities, there are six possible areas of focus in which laws, regulations, and direct agreements with the mining companies, as well as proactive policy interventions, can be designed. The six areas are land and water use; waste management; chemicals and pollutants; tailings disposal; human health risks; and potential environmental risks and the plans to mitigate these risks. It is important to note that adequacy of environmental and social safeguards have to be ensured at all stages of a mining operation, ranging from exploration, construction, operation, to the closure of the mine operation. For governments, regulatory tools have to be

sharpened considerably, with more emphasis on the planning phase (use of Environmental Impact Assessment, occasionally Life Cycle Assessment, sitting restrictions), the design phase (design standards, safe location) and operational phase (pollution standards, waste disposal, emergency response procedures, monitoring).

Audit topics related to mining and minerals

Between 1993 and 2009, SAIs around the world conducted a number of environmental audits on mining and mineral processing. Chapter 4 lists some audits on mining and minerals conducted by various SAIs. The mining-related audits can be found also on the WGEA website: www.environmental-auditing.org

Where mining guideline and other WGEA guidelines might overlap

The nature of mining activities affects the whole environmental media, be it water, land, forest, fisheries etc. We advise auditors who are conducting a mining audit to consider other relevant guidance to ensure that the mining audit is adequate and comprehensive. The following are some of the INTOSAI WGEA guides that may be relevant to an audit on mining:

- *Auditing Biodiversity: Guidance for Supreme Audit Institutions*, 2007 – loss of biodiversity due to mining activities
- *Auditing Government Response to Climate Change*, 2010 – emission of green house gases due to mining processes
- *Auditing Forests: Guidance for Supreme Audit Institutions*, 2010 – forest degradation due to mining
- *Towards Auditing Waste Management*, 2004 – generation and disposal of waste from mining operations

Content and structure of this guide

The main objectives of this guidance material is to increase knowledge about auditing on environmental impacts of mining and mineral by surveying different approaches to the problem and to inspire more audits in this field. The guide should help lower the threshold for commencing audits and encourage SAIs, with or without prior experience, to audit various aspects of their country's impact of mining and minerals' activities.

The guide contains a large selection of problem areas that can be focused on, and it is our hope that it will induce auditors to approach the audit of mining from new angles, and to prompt the many countries that have yet to do audits on mining and minerals to get started in this important field.

Chapter 1 presents background information on minerals and mining sector and definitions related to mining and environmental and social economic problems caused by mining activities. It provides background on the mining life cycle and the stages that mining passes and their corresponding impact.

Chapter 2 presents the key international conventions and standards related to mining, the most important conventions placed in this chapter are those which lead to the control of the mining acess, mining process and mining products.

Chapter 3 of the guide discusses how to select a focus for an audit of mining for your SAI. An approach, which includes a four-step procedure, is presented.

Chapter 4 presents the experiences gained in the INTOSAI community from mining and mineral related audits. The problem areas from an audit viewpoint constitute the framework for the presentation of the audits. Financial, compliance, and performance audits are covered.

Chapter 1: **Mining activities and their impact on the environment**

The purpose of this chapter is to provide basic knowledge and a general overview of information related to mining activities and their impact on the environment. Readers and all SAIs in the world may use this guideline as a reference for conducting mining and mineral audits. Understanding this section will help the auditor at the planning stage in chapter three. Therefore, after going through this chapter the auditor should be in a position to understand the environmental, social and economic problems associated with mining activities. At the end of this chapter the auditor will also be in a position to understand whether there are obligations that will influence national policies.

Most of information in this chapter is an extract from the United Nations Environment Programme reports and from the International Institute for Environment and Development and the World Business Council for Sustainable Development and Mining, Minerals and Sustainable Development (MMSD) Project.

1.1 MINING – WHAT, WHERE AND HOW?

A working definition of mining according to the UNEP could simply be "the extraction of minerals from the earth". The word "minerals" in this case would cover a wide variety of naturally occurring substances extracted for human use. Although this definition is adequate for our purposes, mining can also be seen as a process that begins with the exploration and discovery of mineral deposits and continues through ore extraction and processing to the closure and remediation of worked-out sites. Environmental impacts occur at all of these stages.

Minerals are usually classified in four main groups

- metals;
- industrial minerals (such as lime or soda ash, valued for certain special properties),
- construction materials, and
- energy minerals (i.e. coal).

The minerals extracted in the greatest quantities are those used in construction. It is estimated that some 13 billion tones of stone, 10 billion tones of sand and gravel, and 500 million tones of clay are used annually. With the rapidly growing world population and increasing construction, these figures are expected to increase. This guide focuses primarily on hard rock mining (that is, metals and precious gemstones), although the identification of environmentally and socially vulnerable areas is also relevant for other extractive industries, such as oil, gas, and forestry[1].

How are minerals obtained?

Once a commercially viable mineral deposit has been identified, the immediate problem is how to get it out of the ground. There are essentially two ways of doing this: *by open pit mining and underground mining*. An open pit is a surface excavation, usually conical in shape, dug for the purpose of extracting near-surface bodies of ore. The rock overlying the ore, called the *overburden*, is drilled and/or blasted and loaded into trucks that carry it away from the pit. The ore is then removed for initial processing. Most mines today are surface excavations.

Underground mining, which takes place when minerals lie deep beneath the surface, is only economical for high-grade ore. To get to the ore, a vertical shaft, horizontal entrance or passage (adit), or inclined passageway (winze) must be drilled for ore and waste removal, as well as to provide ventilation.

Placer mining is a widely used technique for extracting precious metals from sand or gravel deposits at or near the surface. The sand or gravel is mixed with water, which is then agitated so that the metals sink. The lighter unwanted material is then washed away. Panning for gold is a simple, small-scale example of placer mining.

Processing of mined minerals

For some minerals, such as those used in construction, processing is usually limited to washing and separation. For others, especially metallic ores, processing and separation may involve a number of chemical and physical steps that can have serious implications for the environment.

The sought-after ores (known as the *values*) must be separated from the less valuable or valueless material in which they are found, known as the *gangue*. The amount of minerals contained in the removed material, expressed either as a percentage or by weight, is known as the *grade* of an ore. Based on (UNEP, 2000) productive economic ore can range from a few pounds per million (gold) to a few percentage points (lead, zinc) or higher (e.g. 17 per cent for potash; 30 per cent for manganese; 40 per cent for iron). The remainder is waste. This means that 1000 tonnes of ore at an average grade of 0.91 per cent will result in 9 tonnes of metal and 990 tonnes of waste[1].

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[1] UNEP, 2000, Industry and Environment, Volume 23 Special Issue 2000, Mining and sustainable development II Challenges and perspectives.

The first step in processing mining products most often consists of crushing or grinding. The combined wastes generated by extraction and milling are known as tailings. The entire process of crushing, grinding, sizing, and separating ore into waste and value is often called beneficiation. After the mineral grains have been liberated in this way, they can be physically separated using one of several methods: magnetic separation, gravity methods or chemical methods. The magnetic and gravimetric methods do not generally present environmental hazards, but the chemical methods do. The most common chemical methods are flotation, capitation, amalgamation and heap leaching. These methods use large amounts of organic compounds, cyanide, mercury and acids (frequently sulphuric), all of which need to be properly handled and are frequently found in the tailings.

1.2 ENVIRONMENTAL EFFECTS OF MINING

The environmental effects of mining vary with the type of minerals and the kind of mine being used. Mining is inherently a destructive activity involving the taking of a non-renewable resource. Some environmental damage is inevitable in any mine – the goal should be to minimize the extent of the effects. Mining effects can be sub-divided for convenience into four categories: the effects of the mine itself, the disposal of mine wastes, the transport of the mineral, and the processing of the ore, which often involves or produces dangerous materials. These activities may take place at the same site, in which case the effects are combined, or they may be separated by considerable distances.

Potential water problems/pollutants, possible air contaminants, reduction of biodiversity, depletion of natural resources, and occupational health problems can be prevented if there is an appropriate management system in place. Other problems, such as habitat destruction at the mine site, can generally be dealt with through site rehabilitation after the mine closes.

1.2.1 Air pollution

The main air quality issue is the dust produced by the working of open pits and by crushing and grinding operations. Dust can also be given off by tailings dams. Workers and nearby communities can be affected by dust in the atmosphere. In addition, particle fall-out around mine sites can contaminate soils and water and damage vegetation.

Mines are also sources of greenhouse gas emissions. CO_2 is produced by energy use and methane is sometimes released from underground operations, especially in coal mines. In the past, some deep mines used ozone-depleting chlorofluorocarbons (CFCs) in refrigeration systems. This practice has now largely ceased.

Smelting (the process in which ore is heated for the purpose of separating it from the gangue) produces very large amounts of air pollutants. Worldwide, the smelting of copper and other non-ferrous metals releases an estimated 6 million tones of sulphur dioxide (SO_2) into the atmosphere each year – 8 per cent of total worldwide emissions.

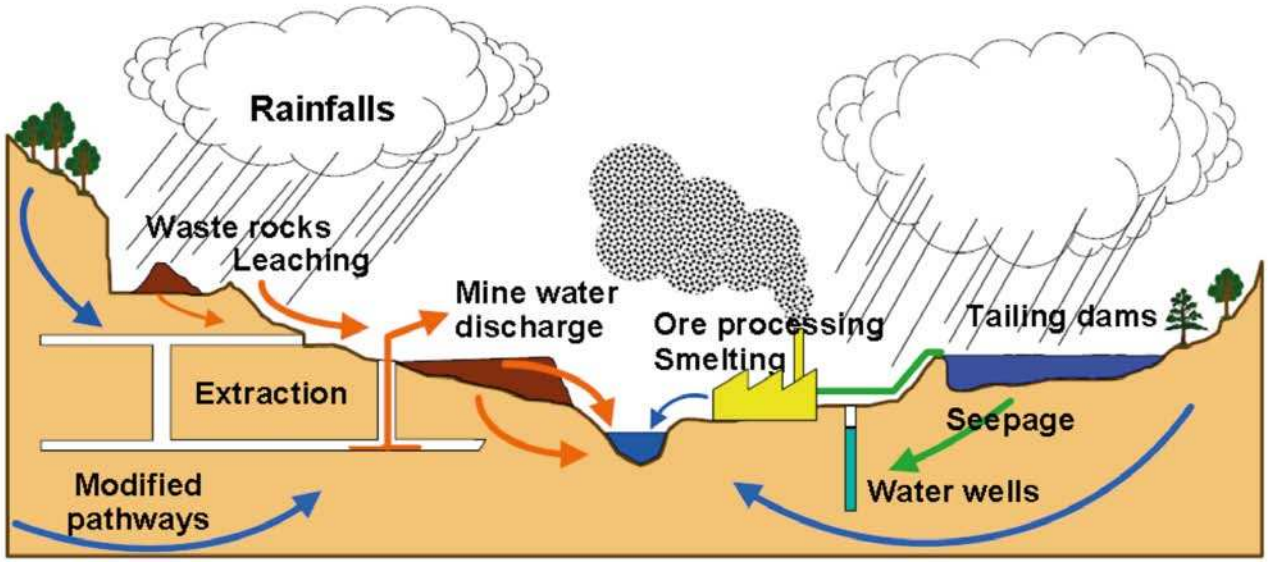
Non-ferrous smelters also emit large quantities of arsenic, lead, cadmium and other heavy metals (except where highly efficient pollution control equipment is used). Smelters may also be regional pollution "hot spots", whose emissions cause severe local environmental damage as well as contributing to more distant or global phenomena such as acid rain and climate change. The photograph below refers some of common greenhouse gases emitted in mineral processing and other pollutant.

Photo 1: **Kara bash copper smelter (Russia)**

Source: **1st MINEO Workshop 25-27 October 2001, GBA, Vienna, Austria**

1.2.2 Water pollution

Figure 1
Simplified mining process and global impacts on water



Source: Francis Cottard[3]

Potential sources of water pollution from mining include drainage from surface and underground mines, wastewater from beneficiation, and surface run-off (see Figure 1 above). A particular problem is acid mine drainage. Many mining operations, especially those extracting ores that contain sulphides such as nickel, copper, iron, zinc, cadmium, lead and coal (if pyrites are present), may produce acidic and metal-bearing solutions resulting from the natural oxidation of the sulphides through exposure to air and water. The combination of acids and metals can have severe effects on the ecology of local watercourses, and the metals can enter and accumulate as they work their way up the food chain. Acid mine water can be a problem for drainage from both underground and surface workings, as well as drainage from waste rock stock piles and concentrated tailings deposits. It can occur while the mine is operating and long after the mine closes, unless specific measures are taken.

Mineral separation processes that make use of dangerous and toxic chemicals such as sulphuric acid or cyanide (e.g. leaching) or organic reagents (e.g. flotation) can be serious sources of contamination if appropriate control systems are not in place. Furthermore, much mine wastewater contains large amounts of suspended solids (ranging from colloidal to materials that settle) originating from the ore itself, from waste material, or from surface installations. These solids can affect aquatic flora and fauna and physically choke local waterways and lakes.

As well as causing water pollution, excavations can also influence the hydrology around the excavated area. Excavations may lead to more rapid seepage into the groundwater, causing nearby streams or wells to become dry. Underground works may cut across aquifers and bring otherwise separate bodies of water together.

Mining causes water pollution in a number of ways:

- The mining process exposes heavy metals and sulphur compounds that were previously locked away in the earth. Rainwater leaches these compounds out of the exposed earth, resulting in “acid mine drainage” and heavy metal pollution that can continue long after the mining operations have ceased.
- Similarly, the action of rainwater on piles of mining waste (tailings) transfers pollution to freshwater supplies.
- In the case of gold mining, cyanide is intentionally poured on piles of mined rock (a leach heap) to chemically extract the gold from the ore. Some of the cyanide ultimately finds its way into nearby water.
- Huge pools of mining waste “slurry” are often stored behind containment dams. If a dam leaks or bursts, water pollution is guaranteed.

Mining companies sometimes dump mining waste directly into rivers or other bodies of water as a method of disposal. This is perhaps the worst water pollution offence.

[3] 1st MINEO Workshop 25-27 October 2001, GBA, Vienna, Austria

Mining operations that dump waste directly into bodies of water

Photo 2: shows tailings pipes from the Mar copper mine in Marinduque entering the sea at Calancan Bay, Philippines

Photo 3: shows the Rosia Montana gold mine in Romania.

Photos by Catherine Coumans, Mining Watch, Canada

1.2.3 Mines and mineral wastes

By nature, mining involves the production of large quantities of waste, in some cases contributing significantly to a nation's total waste output. The amount of waste produced depends on the type of mineral extracted, as well as the size of the mine. Gold and silver are among the most wasteful metals, with more than 99 percent of ore extracted ending up as waste. By contrast, iron mining is less wasteful, with approximately 60 percent of the ore extracted processed as waste.[4]

Disposing of such large quantities of waste poses tremendous challenges for the mining industry and may significantly affect the environment (see photos 2 and 3). The impacts are often more pronounced for open-pit mines than for underground mines, which tend to produce less waste. Degradation of aquatic ecosystems and receiving water bodies, often involving substantial reductions in water quality, can be among the most severe potential impacts of metal extraction. Pollution of water bodies results from three primary factors: sedimentation, acid drainage, and metals deposits.

Photo 4: Uchaly copper mine (Urals, Russia).[5]

1.2.4 Biodiversity and habitat

Mining may result in additional indirect impacts far from the mine site. The most obvious impact on biodiversity from mining is the removal of vegetation, which in turn alters the availability of food and shelter for wildlife. At a broader scale, mining may affect biodiversity by changing the composition and structure of species in an area. For example, acid drainage and high metal concentrations in rivers generally result in an impoverished aquatic environment. Some species of algae and invertebrates are more tolerant of high metals and acid exposure and may, in fact, thrive in less competitive environments. Exotic species (for example, weedy plants and insect pests) may thrive while native species decline. Some wildlife species benefit from the modified habitat provided by mines, such as bighorn sheep that use coal mine walls for shelter.

Forests

Forests are the most biologically diverse terrestrial ecosystems. Tropical forests are particularly diverse and provide the greatest source of endemic plant species in the world. The key direct impact of mining on forest ecosystems is the removal of 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, smaller forests are likely to be particularly sensitive to clearing.

Several landscapes worldwide have been heavily damaged as a result of transient mining activity. In the Choco region of Colombia, for example according to Hilson, gold production increases 7.2% each year, resulting in an estimated deforestation rate of 1,000 ha largely because of intensified levels of exploration activity. According to (Hilson 2002)[6] heavy gold prospecting is also contributing to mass deforestation in Zimbabwe, where an estimated 100,000 ha of land is cleared annually in small-scale mining regions. Further, mining sites are usually highly congested and sanitation is typically poor, so additional deforestation occurs as a result of escalated demands for fuel wood and productive soils are often left contaminated. For example, in the Liptako-Gourma region of West Africa – which includes Burkina Faso, Mali and Niger – small-scale gold mining has intensified since 1984. By the early 1990s, as many as 10 000 people were to be found on a single

4 http://pdf.wri.org/mining_background_literature_review.pdf
5 1st MINEO Workshop 25-27 October 2001, GBA, Vienna, Austria

site). Regional gold rushes have occurred in an anarchic manner, resulting in excessive vegetation clearing and mass trenching. Widespread precious metal extraction activity throughout the Brazilian Amazonian and southwest Colombia, for example, has left several 'moon-surface' terrains devoid of vegetation.

Wetlands and mangroves

Wetlands (including estuaries, mangroves, and floodplains) act as natural pollution filters, as well as providing a unique habitat for aquatic species. Mangroves act as an important interface between terrestrial and marine ecosystems, often providing food and refuge for marine organisms. Wetlands may be destroyed through direct habitat elimination or by pollution from heavy metals and oil spills upstream.

Mining can also contribute to the destruction of mangroves and wetlands through altering upstream watersheds and increased sedimentation. Hilson and others described that the United States has lost at least 54 per cent of its wetlands, and European countries have lost up to 90 per cent of their wetland ecosystems.

Mountain and arctic environments

Extreme northern ecosystems are characterized by cold temperatures and short growing seasons. Arctic ecosystems exhibit far fewer plant and animal species than in the tropics, but they are often highly sensitive to disturbance and the loss of one or two species has a far greater impact. Lichens and mosses are often among the first species to disappear due to pollution and human disturbance. Permafrost degradation associated with mining and oil development may extend far beyond the initial area of disturbance, due to melting of ice, soil degradation, and impoundment of water.

The arctic environment often takes longer to recover from pollution due to the slow speed of biological processes. In addition, the lack of sunlight throughout the winter months makes management of some mining wastes (e.g. cyanide-laced tailings) more difficult.

Arid environments

Water scarcity is the primary constraint in arid environments. Vegetation is limited, but biodiversity is high among insects, rodents, and other invertebrates, especially in semi-arid regions. The main impact of mining on these ecosystems is the alteration of the water regime, especially lowering of the water table and depletion of groundwater. These impacts may result in increased salinisation of the soil and erosion, which eventually lead to a decline in vegetation and wildlife species. In densely populated areas, the competition for scarce water resources makes these ecosystems especially fragile.

Coral reefs

Coral reefs harbor the most biodiversity of any marine ecosystem. Located primarily in the Indo-Western Pacific and Caribbean regions, coral reefs are important links in maintaining healthy fisheries. Reef systems are highly sensitive to human disturbance. Sedimentation from upstream land uses and pollution are among the greatest threats to coral reefs. Mining directly impacts coral reefs through increased sedimentation, especially in cases where wastes are dumped directly in rivers and oceans, as well as through increased pollution of heavy metals.[7]

Case study:
Democratic Republic of Congo

In the Democratic Republic of Congo (DRC) the Kahuzi-Biega National Park was designated a World Heritage Site in 1980 because of its rich biodiversity in both plants and animals. In the late 1990s, armed factions involved in the civil war set up mining operations within the boundaries of the Park to extract valuable minerals such as tantalum and cassiterite. Thousands of Congolese whose lives had been devastated by the war subsequently flooded to the mines in search of income. An estimated 15,000 people were thought to be working at about a hundred sites throughout the Park.

Tragically, not only were tantalum and cassiterite extracted, but also trees, vegetation, and large mammals. The miners hired hunters to feed the people working at the mining sites. Gorillas, elephants, chimpanzees, buffaloes and antelope at first were easily found within proximity to the Park. But, as the months passed, it became increasingly difficult to find large mammals. Hunters searched longer and further. By March of 2001, most of the large animals had been killed. The Grauer's gorilla suffered the most, because this sub-species of gorilla is only found in this area. Before the mining, the total population was estimated to be 17,000 – with 86% living in the Kahuzi-Biega National Park. Now, it is estimated that only 2-3,000 Grauer's gorillas remain. According to Ian Redmond, the chairman of the Ape Alliance, the remaining Grauer's gorilla population is fragmented, which makes them more vulnerable to poaching and inbreeding. The fate of this sub-species is unknown at this time.

1.2.5 Tailings

The tailings that remain after extraction and processing are mostly mud and slurries containing a very high proportion of extremely finely ground material. Due to their vast quantities, liquid nature, and very high content of fine particles (finely crushed coal or ore); their containment and control are an ongoing management concern at virtually all mine sites.

The separation processes used for most metals do not extract all of the minerals present. Tailings therefore contain quantities of metals and other minerals, as well as residues of the chemicals used to extract them. The finely ground material from processing makes contaminants formerly bound up in solid rock (such as arsenic, cadmium, copper, lead and zinc) accessible to water. Acid drainage, which exacerbates contamination by heavy metals,

[6] Hilson, G, 2002. *The environmental impact of small-scale gold mining in Ghana: identifying problems and possible solutions*,: The Geographical Journal, Article date: March 1, 2002.

is often a problem when tailings are exposed to the atmosphere. It arises from the sulphide minerals that are often associated with the commonly mined ores of many metals including copper, gold, lead, nickel and zinc.

Tailings are usually dumped in heaps, released into ponds, or retained by tailings dams. In some cases, submarine disposal or release into rivers occurs. This avoids acid generation but introduces large amounts of suspended solids and contaminants directly into aquatic habitats. Tailings dams, the most common form of disposal, can be large engineering works. The "World Register of Mine and Industrial Tailings Dams" lists eight higher than 150 meters, 22 higher than 100 meters and 115 higher than 50 meters. Six impoundments are known to have a surface area greater than 100 km^2 and a storage volume of over 50,000,000 m^3. Experience has shown that tailings dams represent a potentially serious safety and environmental hazard. An example of tailing failure accident is explained below.

In January 2000, a tailings dam at the Baia Mare mine in Romania split open, releasing more than 100,000 tons of wastewater laden with cyanide and heavy metals into the Tisza river, and eventually into the Danube. The spill killed 1,240 tons of fish and contaminated the drinking water supplies of 2.5 million people. Faced with skyrocketing cleanup costs and only partially covered by its insurance, Esmeralda Exploration Ltd, the Australian company that held the principal interest in the mine, went into a form of bankruptcy to protect its shareholders. Unfortunately, the citizens of the countries affected received no such protection.

Economic Impacts - No Dirty Gold: www.nodirtygold.org/economic_and_financial_toll.cfm

Fish killed from cyanide spill at Baia Mare, Romania.
Photo by Tibor Kocsis

1.3 SOCIO-ECONOMIC IMPACTS OF MINING

This guide is mainly concerned with the environmental impact of mining activities. This section, however, describes some of the socio-economic impacts of mining.

As soon as a mineral is discovered and its mining potential established, the local people are affected. The value of the land increases, and people from outside can start buying land and establishing businesses. Mining and associated activities can have the following effects on the local population.

Displacement of the people

For opencast as well as underground mining, the surface must be cleared of all buildings, structures, and vegetation – not only in the area designated for mining but also in a large area nearby, which is required for external dumps and associated activities. Therefore, all the people living in the immediate area are often displaced or affected.

Loss of livelihood

The people living in the designated areas generally depend on the land for their livelihood. When land is taken for mining and associated activities, these people lose their livelihood.

Changes in population dynamics

Invariably, all the managerial, skilled, and semi-skilled people required for mining and associated activities come from outside the area, because trained personnel are usually not available in populations that rely on the land for their livelihoods. Other people come to the mining areas for trade and other purposes. Thus, the population of the area undergoes a major change over the years, diluting the ethnic population and their culture and religion, reducing the ratio of women to men, and so on. The population may decrease at a faster rate when the mining activities come to an end.

Cost of living

Societies dependent on agriculture and forests usually have low income levels. The development of industrial and other activities in the area increases the economic activity. Increased industrial and economic activities generate more money and increase the buying power of the people directly and indirectly associated with these activities. This leads to an increase in the cost of living, which adversely affects any local people who are not associated with these activities.

Water scarcity

Mining either by opencast or underground methods damages the water regime and reduces the overall availability of water in and around the mining areas. In the sedimentary deposit mining areas, the water table and aquifers are damaged and the availability of water from these sources is substantially reduced.

Health impacts

The health and well-being of the people living in and around a mine are affected due to the pollutants in the air and water, noise and vibrations. The people in the mining complex have to bear the various costs of abating the effects of environmental pollution in various ways. The people working in the mines and associated facilities also get affected by the workplace environment, which can cause various problems, e.g. skin problems, lung diseases, hearing loss, and so on.

[7] See World Resources Institute, *Mining and Critical Ecosystems: Mapping the Risks*, http://pdf.wri.org/mining_background_literature_review.pdf

Infrastructure facilities

Mining and associated activities in the mineral-bearing areas bring about infrastructural development, i.e. roads are constructed, schools and hospitals are established, and communication facili-ties are developed. These changes tend to improve the quality of life of those living within the mining complexes.

Employment opportunities

Mining and associated activities offer employment opportunities to eligible people from the local population. People affected by the mine are often given jobs and trained for self-employment as a result of provisions in any rehabilitation and resettlement schemes. People are also employed in other developmental and mineral-based activities in and around the mining complexes.

Economic disparity and frustration

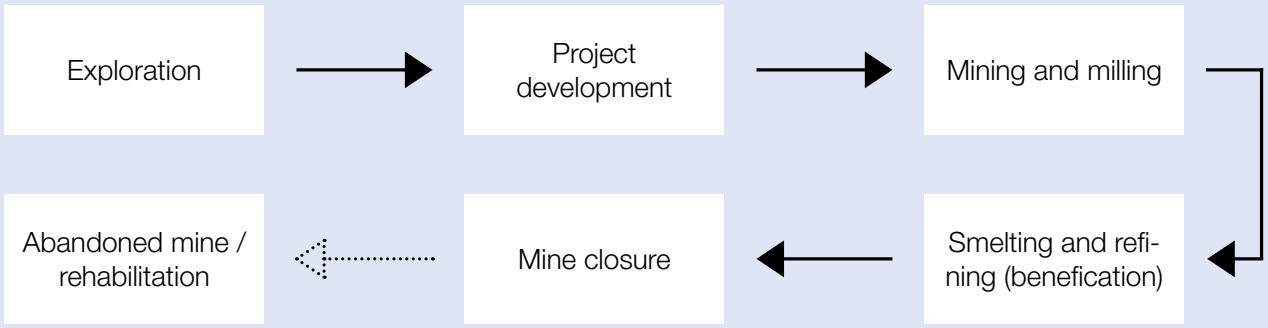
Industrial and economic activities in mining complexes bring about economic disparity among the population living in the complexes. The people employed in the organized activities usually earn more than those employed otherwise; this economic disparity leads to the development of frustrations in the poorest groups of people.

1.4 LIFE CYCLE OF MINING (MINING PROCESS)

Minerals are a non-renewable resource, so mining represents a temporary use of the land. The mining life cycle during this temporary use of the land can be divided into the following stages: exploration, development, extraction, processing, and mine closure.

In this section, we explain the various phases of mining, the associated impact in each phase, and the suggested mitigation or amelioration measures. The figure below sets out the five physical stages of the life cycle of a mine.

Figure 2
Life cycle of mining



1.4.1 The exploration phase of mining

Exploration activities encompass all actions in the field that precede feasibility studies. Exploration activities include initial reconnaissance flights and geophysical surveys, stream sediment studies and other geochemical surveys, construction of access roads, clearing of test drilling sites, installation of drill pads and drilling rigs, benching, trenching/pitting, erection of temporary accommodation, and power generation for exploratory drilling.

Exploration activities also include determining the location, size, shape, position, and value of a body of ore using prospecting methods.

The potential environmental effects of exploration depend on a number of factors, notably:

- constructing new access routes,
- the proximity of surface water to drill sites (particularly those used for potable water abstraction),
- the ecological significance of the affected habitat, and the extent to which access has been improved as a result of exploration,
- the proximity to, and intrusion upon, existing settlements or resources used by local or indigenous people,
- the extent to which local or indigenous communities are voluntarily isolated, or have been exposed to diseases prevalent among exploration workers.

The exploration stage (surveys, mapping, drilling, and so on) generally produces the least-pronounced adverse environmental effects. Still, these can include the clearing of trees and vegetation, displacement and death of wildlife, and landform change through construction of access roads, camps, excavations, pads, pits, holes, and shafts. While frequently dismissed as localised, the impacts of the exploratory phase can displace people, foreclose alternative land uses, create social conflict, and, by building roads, open up sensitive ecosystems to unplanned population influxes.

Potential environmental impacts during the exploration phase of mining include

- land alienation from protection options,
- disruption of habitat and harvesting and fishing activities,
- pollution of water sources from drilling,
- camp garbage, and
- deforestation.

1.4.2 The development phase of mining

The development of a mine consists of several principal activities: conducting a feasibility study, including a financial analysis to decide whether to abandon or develop the property; designing the mine; acquiring mining rights; filing an Environmental Impact Assessment (EIA); and preparing the site for production. Preparation could cause environmental damage by excavation of the deposit to remove overburden (surface material above the ore deposit that is devoid of ore minerals) prior to mining.

The development phase may include such activities as

- overburden stripping and placing,
- road/trail, building and/or helicopter transport,
- drilling and trenching,
- erecting treatment plants, preparing disposal areas, and constructing services, infrastructure such as power line or generating plants, railways, water, supplies and sewerage, laboratories and amenities.

Potential environmental impacts during the development phase

The development and operational stages (extraction) magnify other environmental impacts described in the first stage above. In this stage, large areas of vegetation and topsoil are cleared, and the excavations create potential hazards that include landslides, slope failures, cave-ins, erosion and subsidence. The environment is disturbed by many human developments. Ecosystems and other users of water are deprived by water-intensive practices, and the extraction produces noise, dust, and quantities of solid waste in the form of tailings and waste rock disposal sites (as much as 1,000 units of waste for a single unit of mineral yield).

Toxic chemicals (xanthenes, cyanides, sulphates, and so on) are used in primary processing, and some base metals are themselves toxic (lead, mercury, cadmium). Toxic and otherwise harmful gases can be released (for example, methane - a major greenhouse gas - is released in coal mining). Water quality (surface water, wetlands, groundwater and oceans) can be adversely affected by this extraction phase. Acid drainage from mines and tailings/waste dumps, toxic leaks and overflows from tailings dams or reagent ponds, leaching of metals from waste piles, and sedimentation/erosion from de-vegetated sites and excavations can cause serious localized problems as well as extend for hundreds of kilometers, causing trans-border impacts on people and nature.

1.4.3 The mining and milling phase of mining

This stage generates even more risks to human health and the environment, as explained below.

- Air pollution includes direct emissions of compounds such as sulphur, carbon, nitrogen, and toxic metal particulates, indirect emissions from the fossil fuels used for energy, releases of potentially hazardous dusts and gases in the workplace, and the generation of acidic deposition (acid rain, etc.).
- Water pollution includes all of the above acidic substances, toxic and sedimentary process discharges, leaks, spills, leaching, and surface runoff. Solid and hazardous waste treatment, storage, and disposal issues multiply with the metallurgical residues.
- Wildlife and fisheries lose their habitats.
- There are changes in the local water balance.
- There is increased erosion and sedimentation of lakes and streams.
- Toxins are contained in tailings ponds or leaching solutions.
- Tailings ponds or leaching pads can be unstable and fail.
- There is the potential for acid generation from waste rock and pit walls.
- Heavy metal can leach from acid mine drainage systems.
- Cyanide solutions can be contained at heap leach operations.
- Surface water and ground water can be contaminated from the discharge of acid mine drainage, including heavy metals originating in ore and tailings, and organic chemicals and cyanide originating from milling processes.
- Alienation of land occurs as a result of waste rock piles and tailings disposal areas.
- The mine generates noise and wind-borne dust.

1.4.4 The smelting and refining phase of mining

The smelting and refining phase may include activities such as subjecting minerals to high heat or electro-chemical process to form ingots or bars of pure metal or alloys. On-site processing may include combination to reduce particle size, flotation using selected chemicals, gravity or magnetic separation, electrical or optical sorting, and ore leaching with a variety of chemical solutions. Associated transport, storage of ore and concentrates may pose a handling risk, which can result in localized site contamination.

The potential environmental impacts during the smelting and refining phase of mining include

- heavy metals, organics and sulphur dioxide emissions to air,
- discharges of toxic chemicals, such as sulphuric acid and ammonia used during processing,
- alienation of land as a result of the generation of slag, and
- high energy consumption resulting in indirect environmental impacts.

1.4.5 Mine decommissioning

Mine decommissioning usually occurs when the economic recovery of minerals has ceased. The overall mine decommissioning process is integrated with the overall mine operation planning process. In other words, the mine should be designed and operated with a continual focus on closure outcomes. Factors contributing to cessation of mining activities include

- depletion of reserves that can be mined,
- changes in market conditions,
- changes in the financial viability of the company; or adverse environmental or political conditions.

The mine closure phase may include such activities as

- re-contouring pit walls and waste dumps,
- covering of reactive tailing dumps,
- decommissioning roads,

- dismantling buildings,
- re-seeding/planting disturbed areas,
- ongoing monitoring,
- possible treatment for water quality,
- other mine reclamation activity, and
- abandoning the mine.

Mine decommissioning ultimately determines what is left behind as a benefit or legacy for future generations. If decommissioning and closure are not undertaken in a planned and effective manner, chances are that the site will continue to be hazardous and a source of pollution for many years to come. The overall objective of mine closure is to prevent or minimize adverse long-term environmental, social and economic impacts, and to create a stable landform suitable for some agreed purpose.

Decommissioning and closure plans

Issues to consider in developing a reclamation plan include

- long-term stability of impoundments, slopes, and surface materials,
- safety issues relating to open pits, shafts, subsidence, toxic, or radiological hazards,
- the physical characteristics, nutrient status, and inherent toxicity of tailings or waste rock which may constrain re-vegetation,
- the potential for acid drainage from abandoned pits and shafts, tailings, and waste rock dumps (as a consequence of oxidation of sulfides contained in the ore or wastes),
- the potential for methane emissions from coal mines, and
- the costs of ongoing and post-decommissioning rehabilitation.

The socio-economic aspects of decommissioning are also important, particularly where the existence and economic survival of large communities may depend on a mine. Aside from loss of incomes, the provision of services – such as water, sewerage, electricity, and health care – may be directly linked to the mine. All these issues should be factored into post-closure plans that are adequately costed.

Planning for and progressively implementing effective mine decommissioning can produce significant benefits both during and at the end of operations. These benefits include

- continually reducing liabilities by optimizing rehabilitation works undertaken during the productive phase of mining operations rather than deferring costs to the end of the project,

Some examples on impact of mining – marine waste in Buyat Bay, Indonesia

Some examples on impact of mining. In 2004, the Newmont Minahasa Raya (NMR) gold mine began closing down its operations in North Sulawesi. It left local communities in Buyat Bay and Ratatatok with a dubious legacy: long-lasting environmental damage, economic decline, and a host of health problems. Affected communities have appealed to NMR, a subsidiary of Denver-based Newmont Mining Corporation (which owns 94 per cent of NMR), and the Indonesian government to address their concerns.

Villagers are reporting skin diseases that are believed to be the result of pollution from the mine. Credit: JATAM NMR was the first mine in Indonesia to dump mine waste into the ocean. Known as submarine tailings disposal (STD), the method has been banned in many countries due to its harmful environmental and health impacts. NMR pipes its mining waste approximately ten kilometers from the open-pit mine and discharges it into Buyat Bay at a depth of 82 meters. Since it opened in 1996, the mine has dumped more than 4 million tons of mine waste into the bay.

Coastal dumping of mine waste has destroyed local fisheries in Buyat Bay. Credit: JATAMCoastal dumping of tailings is a grave ecological concern because coastal waters are biologically the richest parts of the oceans. Many open-ocean species depend on the coastal habitat for part of their life cycle. It is also a hazard to public health. In addition to facing severe coastal pollution and the destruction of local fisheries, villagers living around Buyat Bay have reported skin rashes and sores on their bodies, severe headaches, tumors and reproductive health problems. Tailings pipes are notorious for breaking and leaking tailings, both on land and in the sea. NMR's tailing pipe has broken multiple times, leaking waste into water as shallow as ten meters deep and seriously affecting coral reefs and marine life. A 2003 report by the Indonesian Forum for the Environment (WALHI) found that NMR's tailings contain four times the government-allowed level of cyanide and high levels of mercury, cadmium, and arsenic. A team of researchers led by Dr. Ir. Rizal Max Rompas, toxicologist at Sam Ratulangi University, North Sulawesi, also found similar results in 1999; the amount of toxic compounds in the area exceeded the legal threshold.

Extract were obtained from: www.nodirtygold.org/buyat_bay_indonesia.cfm

- providing a basis for estimating rehabilitation costs prior to final closure so that sufficient financial and material resources can be set aside,
- testing rehabilitation designs and/or processes in a site-specific fashion and allowing for scrutiny of the outcomes, with feedback during the active mine life,
- reducing double-handling of waste materials and topsoil,
- reducing the area of land disturbance by using smaller waste landforms and mining paths, and in some circumstances progressive backfilling,
- identifying areas of high risk as priorities for ongoing research and/or remediation,
- facilitating the direct involvement of operations personnel in achieving mine rehabilitation outcomes,
- facilitating the involvement of key stakeholders (especially local communities) in setting priorities for mine rehabilitation,
- reducing the ongoing responsibilities for the site and facilitating timely relinquishment of tenements and bond recovery, and
- easing the impact on local communities that may be economically reliant on the mine.

The potential environmental impacts during the mining decommissioning and closure phase of mining include:

- seepage of toxic contaminants, such as heavy metals, into surface and ground water from acid mine drainage,
- wildlife and fisheries habitat loss,
- alienation of land; re-vegetation failure,
- wind-borne dust, and
- slope and tailings impoundment failure, causing discharge of contaminants and sediments to water.

1.4.6 Abandoned mines

There are many thousands of former mining sites that continue to pose a real or potential threat to human safety and cause health and/or environmental damage in many areas. This is considered a negative legacy of the mining industry and is important because it both demonstrates a lack of care and planning in past practice and adherence to regulations that were inadequate because of the lack of detailed understanding. In general, the presence of abandoned mines negatively influences public perceptions of the industry. Generally, abandoned mines are sites where advanced exploration, mining or mine production ceased without rehabilitation having been implemented at all or without its completion. According to the UNEP working paper on Abandoned mining[8] some elements that contribute to the legacy of abandoned mines include: Regulation – few governments had mine reclamation policies and regulations until the latter part of the twentieth century. Nothing was in place to provide governments with financial security if a mining company was declared bankrupt and was unable to cover the costs of rehabilitation. Ineffective government enforcement, usually due to a lack of capacity, also contributed to the number of abandoned mines. Governments control the permitting system and have a duty to keep updated records and ensure that operators do not abandon operations irresponsibly.

- Loss of mine data – information that was not well stored. The loss of data may be due to a disaster or unscheduled closure.
- Local political problems – in some regions, political problems led to the unscheduled closure of a number of mines. For example, the Kilembe copper mine in Uganda was abandoned in the early 1980s due to political unrest. The Bougainville mine in Papua New Guinea was abandoned in 1989 due to a landowner rebellion.
- Small scale mining – the uncontrolled occupation of mine sites by artisanal or illegal miners has occasionally led to a site being abandoned.

Since abandonment is usually sudden and unplanned, or the mining company has gone out of business, governments are often left responsible for mine closure and rehabilitation. According to the UNEP working paper on abandoned mines, the closure and rehabilitation costs “must be directly or indirectly born by the State. As such the abandoned mines represent not only a major liability for the government but for the affected communities, adjacent areas and society at large: the latter must ultimately bear the financial burden of ensuring appropriate closure.”[9]

Physical considerations

Some abandoned mines present only physical concerns. These concerns include public health and safety, visual impacts, stability issues and dust problems. Accidents related to vertical openings or deteriorating structures are the most common cause of death and injury in abandoned mines. Lethal concentrations of explosive and toxic gases like methane, carbon monoxide and hydrogen sulphide can accumulate in underground passages. It is also possible to encounter pockets of oxygen-depleted air in such workings.

Rock falls and cave-ins from adits or pit walls can be a safety hazard. Unsafe structures include support timbers, ladders, cabins and other related features. These may seem safe but due to weathering they may easily crumble under a person’s weight. Sometimes unused or misfired explosives are triggered. Many abandoned mines become flooded and shallow water can conceal other hazards like tunnels and sharp objects.

Environmental considerations

Abandoned mines and associated features can have a detrimental effect on soil, water, plants and animals. The extent of the effects is not fully known because inventories are incomplete and some abandoned mines are still being evaluated. Generally, the common environmental consequences associated with abandoned mine

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8 www.iied.org/pubs/pdfs/G00882.pdf
9 UNEP working paper on Abandoned Mines April- 2002 No. 28; www.iied.org/pubs/pdfs/G00882.pdf

sites include altered landscape, unused pits, shafts and adits, land no longer useable due to loss of soil or soil contamination, spoil heaps covering the land, abandoned tailings disposal facilities, contaminated aquatic sediments, subsidence, derelict works sites with compacted and polluted soil, burning coal waste dumps and workings, and changes in vegetation.

Socio-economic considerations

The most important socio-economic concern caused by abandoned mines is the loss of employment and business activities in the community, due to the unscheduled closure. The other socio-economic considerations of abandoned mines mostly arise from the physical and environmental considerations. These include the safety hazards caused by abandoned mines that usually result in the loss of lives. The physical impacts of abandoned mines like slope stability, contamination of soils by acid drainage, and other metals released from waste piles usually cause the loss of productive land.

Disturbed lands and unprotected slopes are susceptible to erosion. Uncontrolled surface drainage and subsidence can remove soils and may make large areas unstable. Abandoned mines are often used for the dumping, both legally and illegally, of industrial and household waste, which adds to the problems with contamination.

Financial implications

Funds are required for the rehabilitation of abandoned mine sites. The questions when dealing with abandoned mines include who provides these funds, what mechanisms exist in various jurisdictions to raise these funds, and who is ultimately responsible for the rehabilitation work and the long-term care of the sites?

In some cases, governments are forced to take on the task of rehabilitating abandoned mines when there are no identifiable owners or if the owners have no funds to pay for rehabilitation. In some countries, legislation may be designed to fund the rehabilitation of abandoned mines. The costs are affected by the lack of agreed criteria as to what conditions need to be mediated and what the goals of rehabilitation should be.

Mine closure legislation can enable the regulating authority to control and prevent operating mines from becoming abandoned mines by setting up funds for rehabilitation. The cost estimates to rehabilitate abandoned mine lands are very uncertain. In 2004, Mining and Mineral Sustainable Development report (www.iied.org/mmsd) estimated that between US$32.7 billion and US$71.5 billion would be needed to reclaim the 557,650 abandoned mines they listed in the USA. The biggest cost range was associated with 14,400 mines where surface water contamination was estimated to cost between US$14.4 billion and US$43.2 billion. The Canadian Institute for Environmental Law and Policy estimated in 1999 that it would cost more than C$3 billion to rehabilitate the more than 5,000 abandoned mines in Ontario.

Societies often question who should pay for the rehabilitation of these mines. One opinion is that the government should pay for rehabilitation. Others believe that the previous owners (or their heirs) should be held responsible for such clean-up actions (i.e. the polluter-pays principle in its purest form).

Financial Surety

Governments are usually ultimately responsible for the cost of dealing with the social and environmental problems created by the abandonment of a mine. As a result, it is becoming common practice for some form of financial surety or rehabilitation bond to be established before a mining project is approved. This provision should be designed to guarantee performance and to cover both the technical and financial failure of a mine operator to meet the full obligations at the time of closure or in the event of an unplanned closure. Governments should establish financial sureties in order to protect the environment and avoid the costs of cleaning up abandoned sites.

The cost of a surety can be significant and could deter a potential mining investor. It is important to note that, in the forestry sector for example, the means used for long-term financial surety are highly vulnerable to politically motivated misuse or to corruption (such as long-term hidden funds). Smaller or thinly capitalized companies often have difficulty with surety requirements. It is therefore necessary for governments to have a good understanding of the issues involved in the design and application of a financial surety policy.

For some mine operators, the amount of financial surety is established during project negotiations based on information in the environmental impact assessment and is an estimate of the closure and rehabilitation costs. Another method is for the mine operator to be charged a levy on every tonne of rock or ore mined or processed or on every tonne of concentrate or metal produced.

The financial surety should be available to either the mine operator or the relevant regulatory authority, to pay for rehabilitation. If the mine operator defaults, the money remains in the hands of the regulatory authority. Thus, the funds from the guarantee should be separate and not reachable by creditors in the case of bankruptcy or business failure. Once all stages of rehabilitation have been completed, including a passive care programme, the remaining funds may be returned to the mine operator.

Whichever method is used to establish a financial surety, it is essential that it is regularly assessed, as part of the environmental management of the project, and increased or decreased as necessary. In some countries, contributions to a financial surety are tax-deductible. An audit case from Canada and south Africa in Chapter 4 on topic abandoned mine presents a good example to illustrate how auditors conducted an audit on the topic of abandoned mines.

Mining, by its nature, has environmental impacts in all the phases of a mining project. **Exhibit 1-1** below outlines the main physical environmental impacts of the mining industry, as well as a broad time frame over which they occur. Possible remediation and/or mitigation measures are also summarized.

EXHIBIT 1-1: SUMMARIZED PHYSICAL ENVIRONMENTAL IMPACTS OF MINING PHASE: GENERAL			
ACTIVITY	PHYSICAL IMPACT	TIME FRAME	MITIGATION
	Energy consumption	Energy consumption	Energy conservation measures
	Climate change	Permanent	Evaluate risks prior to operations
	Abandoned equipment	Long term	Adequate dismantling and disposal
	Loss of cultural or archaeological heritage sites	Permanent	Public consultation
	Effects on indigenous populations	Permanent	Consultation, community relations
	Loss of biodiversity	Can be permanent	Rehabilitation
PHASE: EXPLORATION			
Access road construction	Potential influx of population may lead to increased natural resource use	Potentially long term	Minimize where possible
Line cutting	Removal of vegetation. Soil erosion. Possible habitat destruction	Short-term if mitigated	Minimize line width, re-vegetation where necessary
Trenching and pitting	Land scars. Danger to fauna, livestock.	Short term	Infill after sampling, mapping. Re-vegetation
Drilling	Noise and vibration (impact depends on proximity to settlements)	During drilling only	Discussions with public to minimize nuisance.
	Land clearing for drill sites	Short term	Re-vegetation
	Soil and water contamination by oil spills and drilling wastes	Short term	Good maintenance of machinery management of wastes
PHASE: MINING			
In general	Plant and mine noise	Life of mine	
	Blasting vibrations	Life of mine	
	Health and safety risks related to explosives handling	Life of mine	Adoption of stringent safety procedures
	Loss of land	Can be permanent	Rehabilitation where possible
	Solid waste	Life of mine	Implement good disposal practices
Strip or open-cast	Vegetation removal	Life of mine	Reclamation by backfill of depression with waste rock, replacement of topsoil, re-vegetation
	Increased soil erosion	Life of mine	Reclamation as above
	Diversion of water courses	Life of mine to permanent	Reclamation as above
	Increased sediment load in rivers	Can continue post-mine	Reclamation as above
Open-pit	Land scar plus potential danger to inhabitants and fauna	Permanent	Stabilization of pit walls Block access to the area - poses long-term liability problems Pits may be used for waste disposal or filled with water (reservoir/recreational facility)
Shallow underground (less than 300 m deep)	Collapse over workings	Potentially long term well after mine closure	Stabilize workings with waste rock
	Acid mine drainage (surface and underground water contamination due to acidity and dissolved metal content)	During mining and post-mine	Seal workings

EXHIBIT 1-1: SUMMARIZED PHYSICAL ENVIRONMENTAL IMPACTS OF MINING PHASE: GENERAL			
ACTIVITY	**PHYSICAL IMPACT**	**TIME FRAME**	**MITIGATION**
PHASE: MINING			
Deep underground	Land subsidence	Potentially long term	Infill with mine waste stabilised with cement; revegetation
	Disposal of mine water	During mining	Discharge into streams if good quality Use in processing Treat poor quality water before discharge
	Acid mine drainage	Long term, potentially permanent	Neutralization with lime; use of manmade wetlands (densely planted reed beds to neutralize acidity and precipitate metals) if small volumes are involved*
	Seismic disturbances	During mining and post-mine	
Waste rock and overburden disposal	Visual impact	Long term to permanent	Landscaping and re-vegetation
	Land alienation	Long term to permanent	Use of waste as backfill in underground mines
	Airborne dust	During mining	Spraying with water
	Acid drainage	Long term to permanent	Landscaping and re-vegetation
	Erosion leading to increased sediment loads	During mining and post-mine	Landscaping and re-vegetation
	Burning discard dumps (coal)	During mining and post-mine	Compaction, covering and re-vegetation to prevent air ingress
PHASE: ORE PROCESSING/PLANT OPERATION			
Roaster plants and smelters	Suphur Dioxide, Nitrogen Dioxide, and other green house gases emissions can lead to air pollution	Emissions occur during life of mine	Installation of filters on stacks. Conversion of recovered sulphur dioxide to sulphuric acid
	Fallout/spills can cause soil and water contamination	Potentially long term	Depends on mitigation of emissions
	Disposal of smelter wastes (slag) Dumps may cause visual impact	Post mine-life, potentially permanent	Reclamation of dumps
Other plants (tailings, the process wastes are dealt with separately)	Process water discharge can lead to soil contamination and water pollution. Use of hydrological resources	During the life of the mine	Recover effluent for recycling Treat process water (e.g. cyanide destruction) before it is released into tailings dams Maximize use of recycled process water
	Hazardous chemicals handling and disposal	During the life of the mine	Chemicals handling, storage and disposal procedures

* This is a major environmental problem in South Africa

EXHIBIT 1-1: SUMMARIZED PHYSICAL ENVIRONMENTAL IMPACTS OF MINING PHASE: GENERAL			
ACTIVITY	PHYSICAL IMPACT	TIME FRAME	MITIGATION
PHASE: ORE PROCESSING/PLANT OPERATION			
Heap leach operations	Contamination of surface and underground waters by cyanide bearing solutions	During and potentially after the life of the mine	Line leaches pads. Design of closed circuit to recycle leaching solutions Treatment of waste solutions to break down cyanide
Tailings dams	Water pollution from seepage, wind-blown dust	During and potentially after the life of the mine, may be long term	Line the tailings dam Seepage trenches Treatment of process water before damming
	Water-logging of adjacent land		Line the tailings dam Collect and recycle water in seepage trenches Monitor water levels in adjacent land
	Wind-blown dust		Re-vegetation
	Tailings erosion		Re-vegetation
	Tailings rupture - release of toxics (e.g. cyanide)	During and potentially after the life of the mine, may be long term	Requires sound engineering design, continuous monitoring and verification of dam stability Prepare emergency plans
	Poisoning of wildlife drawn to water	Permanent	Block access to tailings dam area
	Land loss		Re-vegetation and rehabilitation to allow future use of land
	Visual effects	Permanent	Landscaping and re-vegetation
PHASE: ACCESS AND ENERGY, INFRASTRUCTURE			
Access roads	Function of proximity to suitable access to infrastructure and energy sources as well as proximity to protected areas, water bodies May cause population influx	Long term	
PHASE: MINE TOWNS/CONSTRUCTION CAMPS			
Worker influx	Forest degradation; water supply contamination; destruction of fauna Sewage	Long term, potentially permanent Life of mine town	Construct necessary facilities
PHASE: DECOMMISSIONING, POST-CLOSURE ACTIVITIES			
	Acid drainage Subsidence Waste dumps	Long term (100s of years)	See mining and processing operations above

Source: This table is extracted from an OECD[10] report, originated from: Acquah, 1995; Balkau, 1998; Balkau and Parsons, 1999; Robb and Robb, 1998; Tosen and Conklin, 1998; Viljoen, 1998; Wilson, 1998a, b.

[10] Environmental Impacts of Foreign Direct Investment in the Mining Sector in Sub-Saharan Africa, OECD GLOBAL FORUM ON INTERNATIONAL INVESTMENT Conference on Foreign Direct Investment and the Environment, Lessons to be learned from the Mining Sector 7 - 8 February 2002, OECD, by Colin Noy Boocock January 2002

1.5 SMALL-SCALE AND ARTISANAL MINING

Most of the activities and impacts described above relate to industrial/large mining operations. However, in some countries, such as Tanzania, Brazil and the Philippines, small-scale mining is also important and may dominate the sector—for example, in Tanzania fewer than 3,000[11] people are employed in industrial mining operations compared with more than 500,000 in small-scale mining using artisanal techniques. Artisanal techniques involve rudimentary methods of ore extraction and processing. Small-scale and artisanal mining activities can have a severe impact on the social, physical and ecological environments.

Artisanal and small-scale mining (ASM) refers to mining by individuals, groups, families or cooperatives with minimal or no mechanization, often in the informal (illegal) sector of the market. Despite many attempts, a common definition of ASM has yet to be established. In some countries a distinction is made between 'artisanal mining' that is purely manual and on a very small scale, and 'small-scale mining' that is more mechanized and on a larger scale. In some West African countries (Mali, Niger and Burkina Faso), small-scale mining is differentiated from artisanal mining by the presence of permanent, fixed installations established once the existence of a body of ore is confirmed. In this paper, the terms artisanal and small-scale mining are used interchangeably.

ASM is characterized by a number of conditions, which are

- a lack, or much-reduced degree, of mechanization and a great amount of physically demanding work,
- a low level of occupational safety and health care,
- inadequate qualifications among the personnel working at all levels of the mining operation,
- inefficiency in the exploitation and processing of the minerals (low recovery of values),
- exploitation of marginal and/or very small deposits, which cannot be economically exploited by mechanized mining,
- a low level of productivity,
- low levels of salaries and income,
- periodical operation by local inhabitants or according to the market price,
- a lack of social security,
- a lack of working and investment capital, and
- workers who do not hold legal mining titles.

These parameters characterize the mining as an artisanal activity. The development of the sector is usually strongly related to the general economic indicators of the country. Although ASM is related to poverty, the sector is perhaps better known for its high environmental costs and poor health and safety record. Many continue to view it as dirty, unprofitable and fundamentally unsustainable. According to a survey carried out by ILO and MMSD, at present there are around 13 million people working in small mines throughout the world, mainly in developing countries. A large percentage of these miners are women, and regretfully, also children.[12]

Small-scale and artisanal mining deserves special note. It is important in many developing countries. The United Nations estimates that this type of mining involves some five million people in China, more than one million people in Africa, and about half a million people in Brazil and in Indonesia. Small-scale mining often has serious environmental consequences, especially gold mining. There are three important problems. The first is the danger from unprotected pits into which people fall, leading to many injuries and deaths. The second is damage to human health from inhaling gases that contain mercury during the amalgamation of gold. The third problem is both environmental and social – the set of problems associated with "unplanned gold rush villages", including an almost complete lack of sanitation, clean water, education, and medical care.

Artisanal and small-scale mining takes place throughout the world, but is particularly widespread in developing countries in Africa, Asia, Oceania, and Central and South America. According to research by MMSD, the most significant ASM countries are Burkina Faso, Ghana, Malawi, Mali, Mozambique, South Africa, Tanzania, Zambia, Zimbabwe, China, India, Indonesia, Papua New Guinea, Philippines, Bolivia, Brazil, Ecuador and Peru.

Other ASM countries are

- in Africa – the Central African Republic, Congo, Ethiopia, Guinea, Kenya, Madagascar, Namibia, Nigeria, Niger, Sierra Leone, Uganda,
- in Asia – Laos, Malaysia, Myanmar, Thailand and Viet Nam,
- in Latin America – Chile, Colombia, Dominican Republic, French Guyana, Guyana, Mexico, Nicaragua, Surinam and Venezuela, and
- in the Caribbean.

Employment

The most recent ILO research undertaken on a global scale estimates that 13 million people are engaged directly in small-scale mining activities throughout the world, mainly in developing countries. The livelihoods of a further 80-100 million people are affected by it. There is a lack of clarity over the actual number of people employed in the sector. Many factors make it difficult to ascertain the full extent of employment, including the informality of the sector, the lack of official statistics, the number of seasonal and occasional workers, and definitional issues. The significance of this is demonstrated by the MMSD Country Study for China, which estimated that somewhere between 3 and 15 million people are involved in artisanal and small-scale mining activities in that county.

In spite of these difficulties, there is no doubt that ASM is an important employment-generating sector.

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11 The World Bank, Environment Department March 1998. (environmental assessment source book, Number 22-update).
12 UNEP, 2000, Industry and Environment, Volume 23 Special Issue 2000, Mining and sustainable development II Challenges and perspectives.

Environment

The environmental costs of ASM are, in general, higher than those of other types of mines; this means that ASM is dirtier per unit of output than medium, large and modern mining operations. Another problem of ASM is the great number of individual polluters, normally concentrated in a particular region, who cause significant local impacts. It is very difficult to control, monitor and enforce environmental violations due to lack of resources and the inaccessible nature of the sector. The ASM produces negative impacts on the physical and social environment during the different stages of mining (exploration, exploitation, processing and closure).

Several landscapes worldwide have been heavily damaged as a result of transient small-scale activity, and intense exploration activity has led to high levels of deforestation, excessive vegetation clearing and mass trenching in some countries in South America and Africa. In the process, large pits have been left uncovered, which have rendered the land unsuitable for any other purpose, and many have filled with water and now serve as breeding grounds for malaria-infected mosquitoes.

Other noteworthy environmental impacts from small-scale gold mining include acid mine drainage (on a micro scale), cyanide contamination (in certain districts), silting, river dredging and alteration, and erosion.

There are multiple reasons for the severe environmental impacts caused by ASM. The most important reasons are

- lack of knowledge, education and training (technical and environmental),
- inefficient technology and limited techniques,
- inefficient administrative management,
- economic limitations,
- lack of access to better techniques,
- lack of information about good practice,
- lack of regulation and enforcement,
- Inadequate environmental legislation.

THE MOST IMPORTANT ENVIRONMENTAL PROBLEMS ARE THE FOLLOWING:				
Mercury pollution	Direct dumping of tailings and effluents into rivers	Acid rock drainage	River damage in alluvial areas	Erosion damage and deforestation
Cyanide pollution	Improperly constructed tailings dams	Improper closure	River silting	Landscape destruction
	Garbage and solid waste	Tropical diseases (malaria)	Induction of subsequent colonization	Cultural damage due to invasion of sensitive tribal land Uncontrolled ASM activities in protected areas

In carrying out environmental audit on mining covered by artisanal and small scale mining where there are no laws and regulations to uphold these operations the auditor in carrying out such audits is expected to apply criteria like:

- estimated environmental costs, liabilities and risks associated with artisans' mining sites,
- systems of establishing priorities and management of mines opened by artisans and small scale miners,
- comprehensive plans for legalization through registering the artisans and issuing them with licenses in order to adhere to environmental laws and regulation.

The photographs below show the mineral processing methods used in Artisinal and small scale gold mininers in Tanzania.

Retort made of a few inexpensive pieces of plumbing

Young boy burning off mercury during extraction of gold

Small-scale miners crushing gold ore

Photos available online at: www.geus.dk/program-areas/common/int_tz01-uk.html

1.6 SUSTAINABLE DEVELOPMENT FRAMEWORK FOR MINERAL SECTORS

Sections 1.3, 1.4 and 1.5 helped us to understand the nature of mining and minerals and their associated impacts. In order to consider the balance between mining activities, environmental conservation and social acceptability, the next part of the Guide discusses the concept of sustainable development.

What is sustainable development?

According to World Commission on Environment and Development, sustainable development can be defined as development that meets the needs of present generations without compromising the need and the ability of future generations to meet their own needs.[13] More specifically, this term refers to a more integrated approach to environmental management and protection that is characterized by three distinct aspects – environment, social, and economic – that should interact holistically and in a harmonized manner, and taking a long-term view.

Sustainable development and mining are not necessarily contradictions in terms. Mining, by its very nature, involves the exploitation of non-renewable resources so is not a sustainable activity. However, minerals create the springboard of infrastructure and the economic base from which the development of sus-tainable economic activity and social benefits to mining communities become possible.

Much of information in this section (Sustainable Development Framework for Mineral Sectors) is based on the book called Breaking New Ground.[14]

The challenge of the sustainable development framework is to see that the minerals sector as a whole contributes to human welfare and well-being today without reducing the potential for future generations to do the same. If the minerals sector is to contribute positively to sustainable development, it needs to demonstrate continuous improvement of its social, economic, and environmental contribution, with new and evolving governance systems. The sector needs a framework within which it should judge and pursue any development.

Mining, Minerals and Sustainable Development Project developed a set of guiding principles, using four dimensions of sustainable development (a governance dimension has been Included, in addition to environment, social, and economic). These are shown in Exhibit 1-2 below.

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13 From the 1987 World Commission on Environment and Development, known as the Brundtland Commission.
14 Breaking New Ground Mining, Minerals and Sustainable Development, 2002, Part 1.

Key areas of action and challenges

The International Institute for Environment and Development embarked on the MMSD project and established the nine key areas of action and challenges. For those countries or SAIs interested in sustainable development approach may critically explore the key areas as explained below.

Viability of the minerals industry

The minerals industry has a key role to play in assisting the mining sector to make a substantial positive contribution to sustainable development. Important changes will take place, and the ultimate shape of the industry cannot be known with any certainty. But two challenges are clear.

"The global market for minerals must develop in terms of internalizing costs over time, while maintaining viable enterprises and rewarding good practice. Creating incentives for industry through market based solutions must go hand in hand with enforcing standards and guidelines."

EXHIBIT 1-2: DIMENSIONS OF SUSTAINABLE DEVELOPMENT
ECONOMIC SPHERE
Maximize human well-being. Ensure efficient use of all resources, natural and otherwise, by maximizing rents. Seek to identify and internalize environmental and social costs. Maintain and enhance the conditions for viable enterprise.
SOCIAL SPHERE
Ensure a fair distribution of the costs and benefits of development for all those alive today. Respect and reinforce the fundamental rights of human beings, including civil and political liberties, cultural autonomy, social and economic freedoms, and personal security. Seek to sustain improvements over time; ensure that depletion of natural resources will not deprive future generations through replacement with other forms of capital.
ENVIRONMENTAL SPHERE
Promote responsible stewardship of natural resources and the environment, including remediation for past damage. Minimize waste and environmental damage along the whole of the supply chain. Exercise prudence where impacts are unknown or uncertain. Operate within ecological limits and protect critical natural capital.
GOVERNANCE SPHERE
Support representative democracy, including participatory decision-making. Encourage free enterprise within a system of clear and fair rules and incentives. Avoid excessive concentration of power through appropriate checks and balances. Ensure transparency through providing all stakeholders with access to relevant and accurate information. Ensure accountability for decisions and actions, which are based on comprehensive and reliable analysis. Encourage cooperation in order to build trust and shared goals and values. Ensure that decisions are made at the appropriate level, adhering to the principle of subsidiarity where possible.

The fundamentals of sustainable development must become embedded in the culture of mining companies in order to have significant and cumulative effects on a whole range of aspects of company life in terms of health and safety of workers as well as long term skills training.

The control, use, and management of land

The development of minerals unavoidably competes with other land uses. Uncertainty over the ability to obtain access to land for mineral exploration and development imposes serious constraints on industry. At the same time, many other actors – including local communities and indigenous people – have vital interests in how land is used and who makes decisions regarding land use. Land use decisions has to be arrived at through a process that respects the principle of prior informed consent arrived at through democratic decision making processes that account for the rights and interests of communities and other stakeholders, while still allowing for the negotiated use of renewable and non-renewable resources. This should equally apply to negotiations for access to land used by people whose rights to that land are not formally recognized by the state or who do not have the capacity to defend those rights.

The decision of whether or not to explore and mine in a certain area must be based on an integrated assessment of ecological, environmental, economic, and social impacts and thus be governed by a land use strategy that incorporates the principles of sustainable development. Decision-making processes must be open to the decision not to mine in circumstances where cultural, environmental, or other factors override access to minerals or where mining would impose unacceptable loss in the view of those it is being imposed on. There must be compensation for any harm that occurs as a result of land use decisions.

National economic and social development

The potential for mining to bring economic and social development, particularly to developing countries, should be harnessed. Mining should bring benefits that can be sustained at the national level even after mining ceases. Potential benefits are by no means automatic, however. Any country that wishes to translate mineral wealth in the ground into human development for its people faces stiff challenges.

Creating and sustaining mineral wealth can play an important role in maximizing human well-being, but it must be undertaken in a way that protects environmental quality and other social and cultural values while recognizing the sovereign rights of governments to act in the best interest of the nation. Economic efficiency of mineral production should be achieved such that the marginal benefits and costs to society are equalized.

A portion of the rents derived from minerals and other non-renewable resources needs to be set aside and re-invested,

in order to ensure a sustainable income when the resource is used up. This may include investing in financial assets or physical and human resources. Revenues should be shared equitably between the public and private sectors and among central, regional, and local levels.

Community development

The challenge at the community level, as elsewhere, is to maximize the benefits and to avoid or mitigate any negative impacts of mining. Priorities and ultimately choices regarding trade-offs relating to different social, environmental, and economic goals need to be determined through participatory processes, involving all relevant actors, including members of the affected community, and in accord with the local context. The relationship between the mining company and other actors needs to be one of collaboration, trust, and respect. The goal should be that no one be made worse off, although it is inevitable that there will be losers in both the absolute and the relative sense.

The economic benefits brought by mining should be shared equitably within communities. To ensure that benefits are sustained, a proportion of the rents should be invested in other forms of capital, such as trust funds, skills training, or social infrastructure. Mining should not leave unacceptable environmental or other negative legacies.

Environmental management

There is a considerable degree of environmental impact associated with most exploration, mining, and mineral processing, and negative impacts can be spread over large areas. Though ideally the minerals sector should not operate at the expense of the environment, in practice there is a balance to be struck if the decision to proceed with an operation is made. The challenge becomes how to optimize the trade-off between environmental damage and the potential development benefits to local and national economies.

The negative effects of minerals and metal products on the environment and human health should be minimized through all phases of the minerals life cycle. Long-term damage should be avoided. No permit should be sought on the basis of a trade-off today against long-term and irreparable legacies that may harm future generations.

An integrated approach to using minerals

The use of minerals is essential for modern living – for meeting basic requirements and the aspirations for improved welfare for current and future generations. Yet current patterns of use face a growing number of challenges, ranging from concerns about efficiency and waste minimization to the risks associated with the use of certain minerals. Added to this is the call for more equitable shares in mineral use world-wide.

The basic needs of individuals and communities for mineral products should be met. Clearly, this requires sufficient income and the availability of minerals. Effort should be made to attain a more equitable distribution of use between industrial and developing countries. While recognizing the essential need for minerals, efficient use should be encouraged to reduce waste, depletion, and pollution. Remanufacture, re-use, and recycling should be encouraged. The social and economic impacts associated with these changes must be assessed and responded to. Life-cycle analysis should be used as a decision-making tool to assess production processes, mineral uses, and the impacts and alternative materials choice. Where the risks associated with certain end uses are unknown, prudence should be exercised.

The flow of information

Sustainable development requires increased openness and greater transparency in information production and dissemination throughout the minerals life cycle. The processes by which information is generated and communicated play a key role in building or undermining trust and in improving all players' ability to negotiate effectively. Systems of accountability and verification are essential to monitor the performance of companies, governments, and civil society. Knowledge needs to be shared and gaps progressively filled.

Artisanal and small-scale mining

Artisanal and small-scale mining (ASM) activities can play a crucial role in providing sources of income in poor areas. The sector is better known, however, for its high environmental costs and poor health and safety record. Irrespective of whether it is a net contributor to sustainable development, the fact remains that ASM activities will persist for at least as long as poverty continues to make them attractive.

ASM's contribution to poverty alleviation and local economic development must be optimized by investing a proportion of the revenue generated in other forms of capital, such as education and alternative income-producing opportunities, and through ensuring that ASM activities are incorporated into broader local development planning. The negative environmental and social impacts of small-scale mining as well as adverse impacts on human health should be avoided or reduced. Where applicable or feasible, alternative economic activities more appropriate for working towards sustainable development should be sought.

The development of 'fair trade' markets for artisanal and small-scale mining products should be encouraged to ensure that producers get a fair return and that they adhere to the practices of sustainable development.

Roles, responsibilities, and instruments for change

Accompanying the rights of different groups are corresponding responsibilities to safeguard the interests of others. The boundaries of responsibility and what is considered good behavior have to be agreed upon and respected if progress is to be made. These will be led by the best practice of the day, but may well change as knowledge improves. Participatory and democratic decision-making structures should be adhered to.

Chapter 2: International responses to the environmental problems of mining

The environment is of global interest and importance. Pollution does not recognize national borders and is transported freely between countries and continents. The international community has recognized this fact, and a number of attempts to improve the environment have been recorded during the last few decades. The most relevant of these agreements regarding mining are presented below. These agreements may be used as a source for developing audit criteria when auditing mining and minerals. Relevant internet sites on the environment and development are used as sources in this chapter, and give more details and references to agreements on the environment and development.

International agreements on nature preservation can affect mining activities in the main three phases of mineral development and marketing, which are access to mining, mineral processing, and mining product controls.

2.1 MINING ACCESS CONTROL

Most international treaties related to nature preservation limit access to mines. In addition to national laws protecting parks, wilderness, wetlands, and nature generally, various international treaties have been developed since the 1940s to protect outstanding natural areas and resources. One example is the UNESCO World Heritage Convention for the Protection of the World Cultural and Natural Heritage (the World Heritage Convention, 1972). It provides for the preservation of outstanding natural and cultural sites by listing them as part of "the world heritage" – in these areas no developed activities such as mining are permitted.

In general, natural areas must be outstanding examples of major stages of the earth's history; significant ongoing ecological and biological processes; superlative natural phenomena; exceptional natural beauty and aesthetic importance; or important natural habitats for in-situ conservation of biological diversity. Once a site is listed, enforcement is left up to each state. The only express sanction is "delisting" a site that a state has failed to preserve adequately (a surprisingly strong motivator for some).

A 21-state elected committee of the treaty parties (the World Heritage Committee) decides which sites to list, and then states are obligated to protect their sites in perpetuity. Over 100 states are parties to the treaty, and 119 "natural" and "mixed" natural-cultural sites had been established as of 1996, including Yellowstone National Park and the Grand Canyon in the United States, the Mount Everest region of Nepal, and Australia's Great Barrier Reef (http://whc.unesco.org/).

Similarly, other important international conventions that limit the access of mining are the 1971 Ramsar Convention on Wetlands of International Importance, Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, the 1968 African Convention on the Conservation of Nature and Natural Resources, the 1979 Bern Convention (Europe) and subsequent European Union Council Directives, and the 1985 ASEAN Agreement on the Conservation of Nature and Natural Resources.

As an example of how a regional treaty can affect access to mining, in 1997 the EU announced it would sue 10 of its member-country Governments for failing to implement their 1995 Natura 2000 agreement (about setting aside a network of habitats for endangered species). National laws inspired by international treaties can also create problems for mining. For example, in 1997 Brazil postponed a major auction of mining rights on a tract of over 2 million hectares in part to allow the Government more time to determine whether it could legally allow mining in the portion of the tract in the environmentally protected Pico da Neblina National Park.

These treaties are potentially very significant for the negotiation of sustainable development in mining, as they can be used to block or redirect mining access and development. One example is the defeat of the Windy Craggy mine proposal by the listing of the Tatshenshini-Alsek Region, British Columbia, Canada, as a World Heritage Site. The Coronation Hill mine in the Northern Territory of Australia was turned down primarily because of Aborigines' claims. Protection of sites under these nature treaties can provide significant leverage to resource-based economies, NGOs and others in dealing with future mining proposals.

The United Nations Convention on the Law of the Sea

Nearly 75 per cent of our planet's surface is ocean. The 1982 United Nations Convention on the Law of the Sea, which came into force on 12 November 1994, is a comprehensive framework for regulating our use, development and preservation of these vast marine areas, including mining and other mineral development in the ocean (http://www.un.org/Depts/los/).

The Convention establishes two different mining regimes depending on the location of the minerals. Mineral resources generally within 200 miles of shore (within territorial seas, "exclusive economic zones" and continental shelf areas) are under the exclusive sovereignty of the coastal state. In these areas (about 35 per cent of the ocean), which are under a nation's jurisdiction, the national laws control mining access, environmental protection and other requirements can

be applied. The other two thirds of the ocean (termed the "International Seabed Area" or "Area") is beyond any nation's jurisdiction and is governed by the Convention under a unique "global commons" regime. The Convention declares the Area's resources to be "the common heritage of mankind" and stipulates that the benefits of mining and other development are to be shared among all nations.

To accomplish this, the Convention established the "International Sea Bed Authority" (ISA), headquartered in Kingston, Jamaica (website: http://www.isa.org.jm). The treaty gives the ISA the power to permit and control all mining exploration and activity in the area. The Legal and Technical Commission makes recommendations to the Council on applications for mineral exploration rights, rules and compliance.

Within areas of a nation's jurisdiction, the treaty obliges states to "protect and preserve the marine environment" and expressly qualifies states' "sovereign right to exploit their natural resources pursuant to their own environmental policies" with the limitation that all development be "in accordance with their duty to protect and preserve the marine environment". Environmental protection provisions require states to adopt laws and regulations to control all forms of pollution, as well as monitoring and environmental assessment. Significantly, for the deep seabed, "international rules, regulations and procedures shall be established", and these will be precedent-setting because states are required to adopt pollution laws and regulations "no less effective than the international rules, regulations and procedures".

Convention on Environmental Impact Assessment (Espoo Convention)

Environmental Impact Assessments or studies (EIAs) are now becoming an international standard for major developments such as mines. Most EIA requirements are coming from multilateral development banks and development assistance agencies. In many countries it is now a legal obligation to conduct an EIA study for development projects, including mining.

The United Nations Economic Commission for Europe (UN/ECE), a grouping of more than 50 northern hemisphere Governments, has negotiated the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) (covering nations in the northern hemisphere). The treaty came into force in 1997, with 17 ratifying countries (chiefly in Europe) as well as the EU. It only applies to developments in a country that will have "significant adverse impacts" across national borders in another country and sets up a regime of notification, EIA preparation, consultation, dispute settlement and research (www.unece.org/env/eia).

Certain other treaties contain EIA provisions, such as the Biodiversity Treaty and the Convention on The Law of the Sea (discussed above), which oblige states to require environmental assessments of projects, policies or programmes likely to have significant adverse environmental effects. Such EIA requirements can be expected to strengthen for mining as the treaties' general environmental standards develop. Some regional agreements require EIAs or exchange of comparable information; the 1985 European Union EIA Directive, for example, requires all EU member states to adopt EIA laws. The 1985 ASEAN Agreement on the Conservation of Nature and Natural Resources in Southeast Asia and the 1974 Convention on the Protection of the Environment between Denmark, Finland, Norway and Sweden (Nordic Convention) are additional examples of international EIA laws for particular geographic regions.

Since EIAs provide an effective and flexible tool in dealing with new mining and industrial development, and since less than half the world's countries have national laws requiring them (such as the United States National Environmental Policy Act), international EIA laws can be of great support and importance to resource-based economies. Countries without such EIA laws may find involvement with one of the regional treaty regimes a good substitute. Progressive international mining companies may agree to prepare or finance EIAs even in situations where national law does not require them, in order to avoid future liability for not meeting "international standards" of performance.

2.2 MINING PROCESS CONTROL

Most of the conventions that hinder the access of mining, as discussed in section 2.1, can create international law requirements that carry over into the mining process. With respect to deep seabed mining, the Convention on the Law of the Sea sets up the framework for developing a complete regime of operational law. With respect to terrestrial mining, the nature/biodiversity treaties can also increase the controls on mining. An example is the Crown Butte Mines Company's New World Mine site adjacent to Yellowstone National Park (a listed site under the World Heritage Convention). In that case, had mining been allowed to proceed, the permits would likely have been conditioned with extraordinary environmental requirements because of United States concern over protecting Yellowstone and not jeopardizing its listing under the treaty. Similarly, when EIA laws apply, the findings of the study can reveal the need to condition the permits with special environmental requirements controlling the operation.

Water quality treaties

Other examples of international standards intruding on the mining process are the various international and regional treaties governing water quality. These include a number of treaties about marine pollution from land-based sources, vessels, and dumping and pollution of fresh water resources. Mining operations whose wastes can reach any of the covered water bodies need to pay especially close attention to the requirements of, and future developments in, these treaties, as many set relatively concrete international standards (http://www.unep.org/).

The Prevention of Marine Pollution from Land-Based Sources

The 1974 Paris Convention for the Prevention of Marine Pollution from Land-Based Sources (applicable to parts of the North Atlantic, Arctic Ocean and North Sea), the 1972 Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, and the 1973 London International

Convention for the Prevention of Pollution from Ships (MARPOL) and its 1978 Protocol are some of the conventions aimed at protecting the marine environment from pollution. These are treaties with provisions for development in or affecting oceans. There are a number of freshwater systems that are the subject of pollution treaties with implications for mining, particularly transboundary pollution.

Air pollution treaties

Air pollution from mining, smelting and related operations is still regulated chiefly by national laws. However, there are several international air agreements that have potential implications for the future of the mining industry.

Convention on Long-Range Transboundary Air Pollution (LRTAP)

There is an increasing number of regional treaties governing transboundary air pollution – emissions originating in one country that cross national borders into another country. The Convention on Long-Range Transboundary Air Pollution (LRTAP) - which has four protocols setting specific emissions limitations on sulphur dioxide, nitrogen oxides and volatile organic compounds - provides very substantive restrictions on some of the basic mineral beneficiation pollutants in northern hemisphere countries (such as the EU, United States, Canada, and Russia). (www.unece.org/env/1rtap.)

The LRTAP Heavy Metals Protocol is particularly significant to the metal mining/smelting industry, both because of its air quality restrictions and because it could ban certain metal production processes and products when their use or disposal could lead to transboundary air pollution. Additional regional treaties are being developed to control transboundary air pollution, with similar potential impact on mining and the environment, for example, in the United States, Canada and Mexico.[15]

Kyoto Protocol

The Kyoto Protocol provides a comprehensive approach for controlling greenhouse gases (GHGs), those chemicals which form a heat-trapping layer in the upper atmosphere and contribute to "global warming", chiefly carbon dioxide and methane. The mineral industry is affected, to the extent its processes release CO_2, methane and other GHGs (www.unfccc.int).

2.3 MINING PRODUCT CONTROL

A paradigm shift is occurring in the way the global community views mining products – a change from the historical view of them as beneficial "commodities" to seeing them as polluting "chemicals". This commodities-to-chemicals view is manifesting itself in a movement toward international treaty restrictions on trade in certain mining end-products, and even outright bans. The trend is to control waste or pollution by controlling or banning the use of the commodity in trade, recycling and/or products.

Mineral hazardous waste and recovery

The mineral hazardous waste and recovery treaties include outright bans on imports and exports of hazardous wastes. The well known Bamako Convention bans imports into Africa and the South Pacific island states, but allows states in each region to trade with each other, subject to certain controls. The 1989 Lomé Convention bans exports from the EU to the African, Caribbean and Pacific States parties, except if the importing country has adequate facilities.

The alternative approach has been to allow hazardous waste transfers, subject to protective requirements like notification, informed consent, and facility adequacy (for example, the 1989 Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal (Basel) and earlier OECD and EC law). In 1993, the EU adopted a detailed regulation greatly limiting hazardous waste shipments within, into and out of EU member countries, even for recovery (UNCTAD). Next, in 1995, a majority of the Basel parties adopted a very controversial "export ban" amendment that prohibits developed countries (generally OECD and EU members) from exporting any hazardous waste to developing countries. The ban applied immediately for disposal, and from 1997 for materials recovery or recycling (UNEP/Guidance).

2.4 BANNING ACTUAL PRODUCTS

The metals-banning trend, lead by international environmental groups and concerned EU countries, has expanded to general consumer products. For example, in 1996, the EU proposed a ban on use of cadmium, mercury, chrome, PVC and lead (except in batteries) in motor vehicles sold within the Community. In 1997, it proposed a ban on the use of cadmium in products which would outlaw nickel-cadmium batteries. One of the EU members, Denmark, proposed a ban on virtually all products containing lead (except batteries). The World Health Organization (WHO) has raised questions about copper in drinking water, which could affect the use of copper in piping, roofing and building materials and other products. The LRTAP Heavy Metals Protocol (discussed in more detail above) and other developing air, water, and land pollution control laws are also focusing on minerals in a way that can ultimately affect products that use those resources.

Another initiative of relevance is the development by UNEP and the Food and Agriculture Organization (FAO) of an internationally binding treaty requiring prior informed consent procedures for international trade in certain hazardous chemicals (including metals). As conceived, prior informed consent is an information exchange requiring that importing countries are advised of

[15] Guruswamy L D & Hendricks B R, 2003, International Environmental Law in a Nutshell; West Group

health or environmental bans or restrictions on chemicals and give formal acceptance to their importation. The EU has urged that prior informed consent be expanded into a "global framework agreement" for management of hazardous chemicals, a position the mining industry opposes, making this UNEP/FAO programme an important one to follow, particularly for importing countries.

The Rotterdam Convention bans the export of crystal asbestos (Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, www.pic.int/).

2.5 PRIVATE-SECTOR GUIDELINES AND CODES

Regional Intergovernmental Organizations (IGOs) and their contribution to law promote the development of international law affecting mining. A very active regional IGO in environmental issues is the OECD (http://www.oecd.org). In addition to the growth in these IGO principles and standards, the industry itself and NGOs are producing an expanding body of international guidelines, standards, best-practices, codes of conduct, technical and management procedures and intra-company rules – both of general application and mining-industry-specific.

Mining industry guidelines

In 1991, the United Nations convened an important roundtable of international mining experts in Berlin to address environmentally sustainable mineral development. From this roundtable emerged the Berlin Guidelines, which set out important mining-environment principles both for the industry and for the cooperating multilateral and bilateral financing institutions (Berlin Guidelines). The Berlin Guidelines note that:

> Sustainable mining activities require good environmental stewardship in all activities, from exploration and processing to decommissioning and reclamation.

To achieve this, Governments, companies and the mining industry should as a minimum make environmental management a high priority:

> …notably during the licensing process and through the development and implementation of environmental management systems which include early and comprehensive environmental impact assessments, pollution control and other preventive and mitigative measures, monitoring and auditing activities, and emergency response procedures.

In addition, the Berlin Guidelines call for environmental accountability, participation of affected communities, best practices "in the absence of specific environmental regulations", environmentally sound technology, technology transfer, additional environmental funding at existing operations, risk analysis and management, reduced trade and investment barriers (paragraph 10) and transparent environmental regulation (paragraph 14). Significantly, the document also produces guidelines for multilaterals, urging financial institutions to demand similar high and detailed standards of sustainable development protection.

The International Council on Metals and the Environment (ICME)

The International Council on Metals and the Environment (ICME) is an "environmental NGO" of major non-ferrous and precious metals, mining and primary metal companies worldwide, organized in 1991 to promote "sound environmental and health policies and practices" in the production, use, recovery and disposal of metals. ICME has adopted an Environmental Charter (www.icme.com).

ISO 14000 standards

A dramatic new entrant in the development of international environmental law standards for the mining industry is the International Organization for Standardization (ISO), an influential NGO based in Geneva, created to promote standardization in goods and services worldwide (www.iso.org). Its ISO 9000 Series standards for product quality are already in widespread use. Of immediate relevance to resource-based economies and the mining industry is its development of the ISO 14000 Series standards, covering environmental management practices.

The enormous impact ISO environmental standards will have on all industry and trade is just beginning to be appreciated. Although ISO standards are supposedly non-regulatory, it can be expected that many countries, international bodies, financing institutions and courts will "adopt" them as interpretative guidance in mining programmes, environmental regulation, contracting policies, financing approvals, and judicial liability rulings. Even where that is not the case, mining companies may feel compelled to conform to ISO 14000 standards as a condition of doing business competitively or to promote their environmental image.

Protected Areas Management System (PAMS)

Protected Areas Management System (PAMS) were developed by the Game Rangers Association of Africa (GRAA) and the International Rangers Federation (IRF) with support from the WWF. PAMS is similar to ISO 14001 EMS and includes the usual primary components thereof, but contains some different emphases and specific requirements unique to conservation.

Environmental non-governmental organizations and their contribution

International (and even some national) environmental NGOs are active participants and influential observers in the formulation and development of international law. The prominent example is the World Conservation Union (International Union for Conservation of Nature, or IUCN), a very respected expert organization that assists countries throughout the world to conserve the integrity and diversity of nature and ensure that use of natural resources is equitable and ecologically sustainable (www.iucn.org). The IUCN has a reputation that makes it a greater player than many Governments in developing conservation treaties and guidelines. It helps to formulate (and assists in the implementation of) the World Heritage Convention, Ramsar, CITES, biodiversity treaties and other international authorities protective of nature and natural resources.

Other NGOs with influence in the international law-developing and - enforcing arenas affecting mining include, to name a few of the more prominent and active in the minerals area, Greenpeace (www.greenpeace.org), Environmental Defense Fund (EDF) (www.edf.org), Natural Resources Defense Council (NRDC) (www.nrdc.org), and the World Wildlife Federation (www.wwf.org).

The special roles of indigenous peoples and local communities

Mining in the past has often proceeded without concern for its negative effects on indigenous populations or local communities. One of the clearest, most evident developments in international environmental law is the trend to reverse this myopia.

Indigenous people and their communities and other local communities have a vital role to play in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

In 1989, the ILO adopted a Convention Concerning Indigenous and Tribal Peoples in Independent Countries (No. 169).

UNCED: Agenda 21[16]

The earth summit, Agenda 21, provides a programme for integrated planning and management of land resources. Its broad objective is to facilitate allocation of land to the uses that provide the greatest sustainable benefits. Its specific objectives are “to review and develop policies to support the best possible use of the land and the sustainable management of land resources”, “to improve and strengthen planning, management and evaluation systems”, “to strengthen institutions and coordinating systems” and “to create mechanisms to facilitate the active involvement and participation of all concerned, particularly communities and people at the local level, in decision-making on land use and management”. For most countries, implementing even a portion of the suggestions would radically change the resource planning and allocation process.

Chapter 13 of Agenda 21 “Mountain Development“ suggests alternatives to minerals development to prevent soil erosion, landslides, and loss of habitat and genetic diversity. Agenda 21 also proposes two programmes relevant to the mining sector, one on inter firm cooperation with government support to transfer technologies to minimize waste and increase recycling, and a second on responsible entrepreneurship encouraging self-regulation, environmental research and development, and worldwide corporate standards.

World Summit on Sustainable Development (WSSD)

The World Summit on Sustainable Development (WSSD), held in Johannesburg, South Africa addressed among other things the issue of protection and managing the natural resources base of economic and social economic development to enhance the contribution of mining, minerals and metals to sustainable development. It included actions at all levels to:

- support efforts to address the environmental, economic, health and social impacts and benefits of mining, minerals and metals throughout their life cycle, including workers’ health and safety, and use a range of partnerships, furthering existing activities at the national and international levels among interested governments, intergovernmental organizations, mining companies and workers and other stakeholders to promote transparency and accountability for sustainable mining and minerals development;
- enhance the participation of stakeholders, including local and indigenous communities and women, to play an active role in minerals, metals and mining development throughout the life cycles of mining operations, including after closure for rehabilitation purposes, in accordance with national regulations and taking into account significant transboundary impacts;
- foster sustainable mining practices through the provision of financial, technical and capacity-building support to developing countries and countries with economies in transition for the mining and processing of minerals, including small-scale mining, and, where possible and appropriate, improve value-added processing, upgrade scientific and technological information and reclaim and rehabilitate degraded mining sites.

The table below shows some other international agreements and initiatives that are not specific to the mining industry but are relevant to it.

[16] Agenda 21 (www.un.org/esa/dsd/agenda21)

EXHIBIT 2–1: INTERNATIONAL AGREEMENTS OF RELEVANCE TO THE MINING INDUSTRY

INITATIVE	DESCRIPTION
Global Compact	Launched in 1999 by the Secretary-General of the UN, a commitment by a network of organizations from business, labor, and civil society to support a global set of principles for corporate social responsibility. Mechanisms for more specific sector-by-sector agreements are being explored.
Global Reporting Initiative (GRI)	Established in 1997 by the Coalition for Environmentally Responsible Economies (CERES) in partnership with UNEP to develop globally applicable guidelines through a multi-stakeholder process for reporting on economic, environmental, and social performance. The GRI is now developing specific guidelines for the mining sector.
ISO 14001	ISO 14001 is an internationally recognized environmental management system (EMS) standard developed by the International Organization for Standardization (ISO) in response to the 1992 Earth Summit. Approximately 30,000 companies in over 40 countries have received ISO 14001 certification and as many as 300,000 companies have based their EMSs on the standard, without seeking certification.
OECD Guidelines for Multinational Enterprises	Adopted in 1976 with the objective of strengthening the basis of mutual confidence between enterprises and government authorities and promoting the economic, social, and environmental benefits of foreign direct investment and trade while minimizing the problems. A thorough review process was undertaken in 2000.
OECD Principles of Corporate Governance	Adopted in June 1999, the first multilateral effort to produce a common language of corporate governance. The principles are intended to assist both OECD and non-OECD governments evaluate and improve their own framework for corporate governance and to provide guidance and suggestions for stock exchanges, investors, corporations, and other parties that have a role in developing good corporate governance.
UNEP Declaration	The UNEP Declaration is a voluntary commitment to adopt improved sustainable production practices involving the continuous application of an integrated preventative strategy applied to processes, products, and services. In October 2000, the International Council on Metals and the Environment became a signatory to the UNEP Declaration. The Declaration is a set of high-level commitments that will need to be advanced with and through members of the International Council on Mining & Metals over time.
Aarhus Convention, 1998	Establishes rights to access to information, public participation in decision-making, and access to justice.

Note: This table is extracted from the report of the mining, minerals and sustainable development project May 2002, “Breaking new ground”. The original sources are www.unglobalcompact.org; www.un.org/esa/sustdev; www.oecd.org; www.iso.org; www.globalreporting.org; and www.unep.org/Documents/Default.asp?DocumentID=174&ArticleID=2621.

Chapter 3: **Choosing and designing the audit**

The purpose of this chapter is to guide Supreme Audit Institutions (SAIs) and auditors as they choose and design audits of the impacts of mining on society, the economy, and the environment.

Selecting and determining the scope of audits of mining can be a challenge for SAIs. There are so many ways of describing the scope from initial ownership and access rights for exploratory purposes through mining and processing, to the use of the end product or disposal of waste materials. The responses of governments include laws regulating mining and mineral processing activities that in some cases are based on the paradigm of "sustainable development" – development that meets the needs of the present without compromising the ability of the future generations to meet their own needs.

For mining, this means focusing not only on the traditional economic concerns, but also on new social, economic and environmental concerns, particularly in developing nations with resource-based economies. This includes a wide range of conventions, protocols, declarations, treaties, standards, codes and recommendations relating to environmental, social and economic norms.

This chapter is designed to help SAIs and auditors make sense of all impacts that may arise due to mining activities. The chapter mainly includes the following four basic steps as shown in the Exhibit 3-1 below.

Step 1: Identify the environmental threats of mining in your country

Step 2: Identity the government's responses to these threats in your country and relevant players

Step 3: Choose audit topics and priorities

Step 4: Decide on audit approaches: scoping the audit

EXHIBIT 3–1. BASIC STEPS FOR CHOOSING A TOPIC AND APPROACH FOR AN ENVIRONMENTAL AUDIT ON MINERALS AND MINING

STEP 1: ARE THERE ANY MINERAL AND MINING ACTIVITIES IN THE COUNTRY? WHAT ARE THE MAIN THREATS TO THE ENVIRONMENT CAUSED BY MINERALS AND MINING? (IDENTIFY THE MINING STAGES AND THREATS TO ENVIRONMENT)		
General environmental impacts	Reduction of biodiversity	Other pollution impacts
Potential water problems/pollutants	Depletion of natural resources	Damage to historic and cultural resources
Possible air or soil contaminants	Occupational health impacts	Land degradation
STEP 2: WHAT ARE THE GOVERNMENT RESPONSES AND WHO ARE THE PLAYERS? (ADEQUATE STAKEHOLDER ANALYSIS SHOULD BE DONE)		
WHAT	**WHO**	**HOW**
Environmental policy design and regulations	Environmental regulation agencies	By enforcing and monitoring the compliance with the regulations
Dealing with acid drainage	Research initiatives and programmes e.g. Mine Environmental Neutral Drainage	Installing a water treatment plant. Passing the water through an artificial wetland in which organic matter, bacteria and algae work together to filter, absorb, and precipitate out the heavy metal ions and reduce acidity.
Tailings storage facilities. Land-use planning and management (Agenda 21); surveillance; resource-fees, (royalties)	The mining company	Good design, close consistent routine attention over a long period. Ensure that all designs are based on the highest design standards possible. Have an international system certification for designers or at least some formal pronouncement by engineering bodies as to the minimum qualifications for undertaking such task.
STEP 3: CHOOSE AUDIT TOPICS AND PRIORITIZE		
Potential water problems pollutants; Possible air or soil contaminants; General environmental impacts; Other pollution impacts		
STEP 4: WHAT AUDIT APPROACH TO USE?		
Financial management and regularity	Performance measurement and results	Public education
Compliance with agreements, laws and policies	Accountability, coordinator and capacity	Reporting to client and public
Policy coherence	Scientific research and monitoring	

These steps are often included in the planning stage of an audit but they are not carried out explicitly. We recommend that in the mining audit the steps should be followed. These steps should be used to define the objectives, scope, and criteria of a single audit on minerals and mining. During the planning stage auditors are advised to understand the environmental problem and governmental responses in mitigating the negative consequences in the respective country.

Further, auditors should prioritize and limit the audit area.

We elaborate on the four steps below.

STEP 1: IDENTIFY IF THERE ARE ANY MINERAL AND MINING ACTIVITIES IN YOUR COUNTRY, AND WHETHER THERE ARE ANY ENVIRONMENTAL THREATS RELATED TO THESE ACTIVITIES

Chapter 1 gives a good background on minerals and mining life cycle and some of the common global threats and concerns and chapter two discuss international and national responses to the environmental issues associated with mining. However, to develop domestic approaches for auditing minerals and mining environmental impacts, SAIs must understand the situation in the country and the main threats associated to the mining life cycle. All kinds of reports can be a source of audit information auditor should also consider the use of an environmental expert during this stage.

KEY QUESTION: What kind of environmental problems arise?

Environmental problems differ from one type of mineral to another. However, there are some common environmental impacts e.g. loss of habitat. Auditors could consider the activities involved at every stage of the mining process – in other words, the prime drivers of the environmental problems. They could include

- exploration – drilling and exploration excavations,
- project development – construction of roads and buildings, erection of treatment plants, overburden stripping and placing,
- mine operation – heap-leaching of tailing dumps, bio-leaching of surface heaps or deposits and solution mining of buried deposits,
- beneficiation – on-site processing may include combination to reduce particle size, or flotation using selected chemicals, and
- mine closure –incompatible landscape features and contamination of soil or water.

Gold and diamond mining have slightly different environmental impacts. The environmental and social challenges that the gold industry faces include

- the use of cyanide in the production process, and
- increasing environmental and social regulation.

In diamond mining, the environmental impacts depend on the mining method applied. The environmental impact of diamond mining is similar to those existing in open-pit mines. The problem stems from waste disposal, leaching, and ground water pollution.

KEY QUESTION: What are the short and long-term effects on the environment, economy and society?

The main social, environmental and economic impacts are well described in sections 1.2 and 1.3 in chapter 1. The main affected sectors are the land and human settlement sectors, because mining displaces people, undermines their livelihoods, and causes significant changes in population dynamics. The other environmental problems affect the water sector – water is polluted and becomes scarce. Another sector highly affected by mining activities is the health sector – people living in and near mining complexes get affected by the pollutants.

On the other hand, the planning and development sector also is not left untouched. Infrastructure facilities such as roads, hospitals, and schools are improved by mining companies. Employment opportunities are enhanced but there is also economic disparity, cost of living increases, and frustration among the people in and near the mining area.

THE EXHIBIT 3-2 BELOW DESCRIBES THE LINKS BETWEEN MINING THREATS ON THE ENVIRONMENT, SOCIETY AND THE ECONOMY, THEIR CAUSES AND CONSEQUENCES.		
THREAT TO THE ENVIRONMENT	**CAUSES**	**CONSEQUENCES**
General environmental impacts. Ecology and biodiversity. Resources issues. Social concerns.	Destruction of natural habitat at the mining site, processing site and at waste disposal sites. Destruction of adjacent habitats as a result of emissions and discharges. Changes in river, groundwater regime and ecology due to flow modification. Alteration in water tables. Changes in landform. Land degradation due to inadequate rehabilitation after closure or lack of it. Land instability. Danger from failure of structures and dams. Abandoned equipment, plants, buildings etc and waste. Resettlement	Large – scale waste disposal operations may present a risk of catastrophic failure of tailings dams or heaps, collapse of dump heaps, such failure may lead to major loss of life at the site or in nearby communities i.e. loss of natural habitat, loss of rare and endangered species. Loss of agricultural land and forestry resources. Loss of livelihood and cultural heritage or religious sites. Effects on indigenous people
Potential water problems/ pollutants. Hydrogeology and water quality.	Suspended solids and sediment from runoff and processing operations. Acids from various processes. Heavy metals from waste and concentrates around the site; sulphate, thiosulphate, polythionates, etc, from acid drainage; arsenic and other salts from oxidised mine waters. Mercury if used in the process, or from ores. Cyanide if used in leaching processes. Oil and fuel from ancillary operations	Oxidation of iron content adds discoloration and deoxygenating of waters due to the problems of metal toxicity. Excessive discharge will damage natural ecosystems and affect local fisheries and may deprive downstream population of a clean water supply. Wildlife habitat loss. Alienation of land. Re-vegetation failure. Effects on surface and ground water resources.
Possible air contaminants. Air quality.	Dust from the site or from processing. Natural gas from underground mines. Heavy metals, organics.	Pollutants disease or death. Increase potential for respiratory disorders.
Other pollution impacts. Occupational and public health concerns.	Drainage from mining sites. Pollution from mining operations in riverbeds. Effluent from minerals processing operations. Sewage effluent from the site. Oil and fuel spills. Soil contamination from treatment residues and spillage of chemicals. Leaching of pollutants from tailings, disposal areas and contaminated soils. Air emissions from minerals processing operations. Dust emissions from sites close to living areas or habitats, and sulphur dioxide emissions to air discharge of toxic chemicals such as sulphuric acid and ammonia used during processing.	Hazards from process chemicals or explosive. Severe poisoning – potential increase in disease vectors. Alienation of land as a result of the generation of slag.

STEP 2: IDENTIFY THE GOVERNMENT'S RESPONSE IN YOUR COUNTRY

In general, governments play an important role in protecting the environment in many ways. They "mainstream" environmental matters into the economy, i.e. by integrating environmental issues in the development planning process. Essentially, the government makes the environment feature in decision making, and in the formulation, implementation and evaluation of policies, strategies, programmes and projects. SAIs do not audit the environment, they audit the impact of government policy and programmes. They need, therefore, to understand what the government is doing to mitigate or prevent environmental threats through programmes and policy tools.

In identifying the government's response, the auditor has to know if the government has mapped the environmental, social and economic problems related to mining, through national commitments, policies, programmes, monitoring, and enforcement of its regulations.

KEY QUESTION: What is government doing about environmental threats of mining and minerals? Are there obligations that will influence national policies? Can they be used as audi Criteria?

National laws related to mining can apply across the full spectrum of the mining life cycle, from initial ownership and access rights for exploratory purposes, through mining and processing, to the use of the end product or disposal of waste materials.

Governments have a variety of legal powers and tools that they can use to address environmental problems and activities. Legal powers include legislation (acts of parliament or congress), regulations, permits, licence bylaws, and ordinances. Governments have different roles and responsibilities over the whole mining process, including environmental issues associated with mining.

Environmental regulations

Environmental laws and regulations have the primary goal of ensuring the protection of communities' ecological and social values. They provide a stable framework within which investment and operational decisions can be made. A SAI or an auditor can use them as a source of criteria during their audit planning.

Environmental regulation alone is unlikely to solve environmental problems, especially in countries with endemic production inefficiency. The environmental approach of state-owned enterprises can reflect inefficient operating regimes, excess capacity, breakdowns and shutdowns, and poor management proce-dures that often contribute to worsening pollution. At best, environmental regulation comprises one element of a public policy for environmental management of the mining sector. It has therefore been argued that, in addition to environmental regulation, public policy to promote technical change and foster economic efficiency is most likely to contribute to sustained and competitive improvement in the long-term environmental management of non-renewable resources. This is true, because environmental degradation is greatest in operations working with obsolete technology, limited capital, and poor human resource management. It is also relevant for small-scale mining operations.

Matters covered by environmental regulation may include

- environmental impact assessment or other environmental planning,
- nature conservation, national parks, protection of flora and fauna, endangered species,
- cultural heritage, indigenous cultures, landscape protection, and scientific sites,
- water quality protection,
- clean air laws to limit air emissions and human exposure,
- control of soil contamination and land protection from weeds and pests, and
- other issues, such as noise, waste disposal, and chemicals control sometimes regulated by environmental laws.

Mining legislation may include regulatory provisions relating to

- safety of structures and operations, limiting exposure to chemical hazards,
- wastewater retention and treatment, management of contaminated runoff,
- soil erosion control and re-vegetation during and after operation, and
- solid waste disposal; and restoration of sites and disposal of equipment.

Of the matters generally covered by environmental regulation, the major issues for mining companies are emissions (effluent and air emission standards); habitat and wildlife protection; and rehabilitation and mine safety, including tailings dams.

Regulatory controls and instruments

The instruments available to governments for influencing environmental practices in the mineral industry can be divided into the following three categories

- environmental regulations (administrative regulations),
- education and training, and
- economic instruments

KEY QUESTION: Do the environmental regulations include provision for mining? Is there EIA requirement for mining? Is it followed? Are the regulations efficiently enforced?

In order to encourage a high level of government accountability and achieve continuous improvements, a regulatory system should advocate a pollution reduction ethos and involve negotiation between the government agency and the mining company on acceptable standards. Prescriptive regulations can be unduly restrictive and quickly become outdated in the face of advances in technology.

Command and control policies are representative of the early era of environmental regulation, but they still dominate the approach to environmental regulation in many countries. These policies are characterized by a reliance on predetermined environmental standards that have to be observed by mine operators. The standards are often general in nature, applying to all industries and all parts of the country. The Government's role is to establish the standards and to enforce them through monitoring operations and levying penalties on operators that do not observe them. Command and control mechanisms tend to rely on administrative agencies and judicial systems for enforcement.

The response of the mining industry to command and control mechanisms was largely reactive over the past few decades. Companies are anxious to improve their reputation and act as "good corporate citizens". In addition, the introduction of international standards setting out guidelines for the development and implementation of an Environmental Management System has helped many companies to assess their risks and impacts and to establish management systems to minimize them. As a result, Governments can go beyond the traditional incremental and punitive type of environmental regulation and address the real causes of environmental management shortcomings – a lack of capital, technology and skills, including an inability to innovate.

Many companies and a number of industry associations have favored self-regulation, arguing in support of the ability to manage themselves. Self-regulation is also a way to ensure that agencies/companies are responsible and accountable for the environmental consequences of their choices and actions. Thus, in countries where a system of environmental regulations and standards does not yet exist, the mining company must itself ensure that all likely issues are competently addressed. The disadvantage of this approach is that industry compliance with environmental requirements might not be achieved.

Education and training

Legal provisions must be enforced if they are to be meaningful, and enforcement problems often result from shortages of adequately trained staff and equipment. Hence, the importance of education and training programmes (particularly and increasingly proactive programmes of research, information, education and training, incentives and awards for good performance) should be undertaken to supplement the regulatory approach. These programmes can be very effective in small operations, such as small-scale mining. The industrial licence and permit fees in many countries are established so as to recoup at least some of the costs of these programmes.

Mining codes

Mining is unique among industrial activities in requiring a set of regulations of its own, usually embodied in a mining law or mining code. A country's mining code is the combination of statutes, regulations and agreements that govern the allocation, tenure, and operation of mining rights. Separate legislation usually covers foreign investment, taxation, foreign exchange, labor, and environmental and other regulatory matters. Increasingly, environmental protection is included in mining legislation and so has to be viewed as part of the mining operation, alongside exploration, mining, metallurgical processing, and marketing.

Institutional issues

It is becoming more common for environmental ministries to focus on the development of environmental protection criteria and standards, the approval of planning procedures, and the review of Environmental Impact Assessments (EIAs), while mining ministries undertake the implementation work of administering plant permits, regulating discharges, and supervising rehabilitation bonds.

Appropriate practices should be identified and required outcomes and objectives should be clearly defined. These practices and objectives then need to be promoted at the different levels of Government to ensure consistency of approach and effective policy coordination between Government agencies.

In addition, the role of the various Ministries concerned, such as Finance, Planning, Environment, Land Resources and Labor, needs to be clearly defined in relation to mining operations, thus avoiding duplication of functions. It is essential to adopt a coordinated approach towards environmental policy and its implementation by the various Government agencies involved.

Policies and programmes

Governments can formulate environmental policies. Policies tend to set directions, but are usually not prescriptive or enforceable. A policy might be a statement of intent or of a desired outcome. In some cases, policies can be supported by specific procedures (action plans) and (funded) programmes.

For instance, governments can have a number of enacted policies, strategies, programmes and legislation to address environmental concerns. However, successfully implementing programmes requires that they have enough monetary resources, skilled people, goals and authority. Governments should set performance measurements for implementing their policies or programmes.

The national budget

There are a number of tools that can help to ensure the integration of environmental concerns in the planning process. These are discussed below:

Environmental policy instruments

The national budget is one of the tools the government can use to implement policy. How effectively the environment is mainstreamed into various budgetary provisions, implicitly or explicitly, is ultimately the measure of how effectively or otherwise the government can effect environmental conservation in mining areas.

Environmental assessments of mining activities

Another policy instrument that helps to balance the imperatives of economic development and environmental conservation is the Environmental Assessment (EA). EAs are observed at two levels; the Strategic Environmental Impact Assessment (SEA) and the Environmental Impact Assessment (EIA).

Accoordind to the UNEP, Environmental Impact Assessment (EIA) as a systematic process to identify, predict and evaluate the environmental effects of proposed actions in order to aid decision making regarding the significant environmental consequences of projects, developments and programmes.

EIA helps the stakeholders with the identification of the environmental, social and economic impacts of a proposed development before a decision is taking on whether or not to proceed. Particular attention is given in EIA practice to preventing, mitigating and offsetting the significant adverse effects of proposed undertakings.

National laws require every mining project to conduct an EIA/ study before the mining project begins. Normally, the decision about whether the proposed project will proceed is based on the EIA report. Among other things, the EIA report should include the following objectives:

- To meet the environmental requirements and directives under statutory and legislative instruments such as acts and regulations, standards, international agreements etc.
- To provide a single document that will satisfy the various authorities that are concerned with the regulation of the environmental impacts of mining.
- To describe the relevant baseline environmental conditions at and around the proposed site.
- To describe briefly the mining method and associated activities so that an assessment can be made of the significant impacts that the project is likely to have on the environment during and after mining.
- To describe how the negative environmental impacts will be managed and how the positive impacts will be maximized.
- To set out the environmental management criteria that will be used during the life of the project so that the stated and agreed land capability and closure objectives can be achieved and a closure certificate issued.
- To indicate that resources will be made available to implement the environmental management programme

On the other hand the Strategic Environmental Assessment (SEA) according to the UNEP refers to a formal, systematic process to analyze and address the environmental effects of policies, plans and programmes and other strategic initiatives. This process applies primarily to development-related initiatives that are known or likely to have significant environmental effects, notably those initiated individually in sectors, such as mining sector, or collectively through spatial or land use change. As with EIA, SEA includes social, health and other consequences of a proposed action and their relationship to sustainable development concepts and strategies.

Why is SEA important?

SEA extends the aims and principles of EIA to the higher levels of decision-making when major alternatives are still open and there is far greater scope than at the project level to integrate environmental considerations into development goals and objectives. In addition, SEA can provide early warning of large-scale and cumulative effects, including those resulting from a number of smaller-scale projects that individually would fall under thresholds for triggering a project EIA.

How does SEA compare to or differ from EIA?

Some of the distinctive characteristics of SEA compared to EIA include:

- Greater uncertainty about the effects of a policy as compared to a project (concrete actions);
- Broader range of environmental consequences to be considered (from implications to impacts);
- Wider set of linkages and trade-offs with economic and social issues (e.g. a national energy policy or plan compared to a power station); and
- Larger scale/ longer time frames to take account of environmental effects and consequences (e.g. implications of CO2 emissions for climate change).

Yet SEA and EIA also have many similarities and a common foundation. SEA has developed largely as a response to the levels and types of decision-making not covered by EIA. In doing so, SEA has derived, adapted and implemented EIA arrangements, procedure and methodology, particularly at the plan and programme level. Other process models also have been adapted, particularly at the policy level where integrative appraisal and environmental “tests” compress the basic steps followed in EIA, such as screening and reporting.

Challenges for environmental assessments

The challenges posed to environmental assessments of mining projects are twofold.

First, to ensure that environmental, social and health costs of the proposed mining project are given adequate consideration in determining the economic viability and acceptability of alternative project scenarios. Secondly, to ensure that adequate control, mitigation or protection measures are incorporated in proposed mining project design, implementation and mining decommissioning plans. This requires both effective environmental legislation and enforcement by regulatory institutions, and sound environmental management practices by private and public sector mine operators.

Environmental management systems

Environmental management systems (EMS) seek to integrate environmental responsibilities into everyday management practices through changes to organizational structures, responsibilities, procedures, processes, and resources. An EMS provides a structured method for company management and the regulating authority to be aware of and control the performance of a project. EMS can be applied at all stages of the life cycle – from identification of a deposit to mine closure. The stages in an EMS cycle are:

- organizational commitment,
- environmental policy,
- socio-economic impact assessment,
- environmental impact assessment,

- community consultation,
- setting objectives and targets,
- environmental management plan,
- documentation and environmental manual,
- operational control and emergency procedures,
- training,
- emissions and performance monitoring,
- environmental and compliance audits, and
- reviews.

The EMS is a repetitive cycle, with each stage being continuously revisited and improved on each visit. Although it is designed as a tool for the company, an effective system provides an easy way for the regulatory authority to check compliance. The responsibility for setting up and running an EMS lies with the company.

KEY QUESTION: What are the national targets and objectives in this field?

The national targets and objectives in this field may include:

- protection and management of the environment for sustainable development,
- integration of environmental management and economic decisions at an early stage to avoid potential problems,
- prediction of the consequences of a proposed mine from environment, social, economic and cultural perspectives and development of plans to mitigate any adverse impacts, resolve conflicts and enhance positive outcomes,
- provision of avenues for involving the public, proponents, private and government agencies; and interested as well as affected people in the assessment and review of the proposed mine in an open, transparent and participatory approach.

KEY QUESTION: Who are the main players that have an impact on the environmental problems? What are their roles and responsibilities?

The auditor needs to identify the major players involved in any environmental related activity. There can be many players, with both converging and diverging interests. Nevertheless, the auditor should define each player's role, activities and scope of influence.

Players will include departments and agencies at central government and local government levels. Government controls over environmental aspects of minerals and mining activities vary from country to country. In many countries, the government has the authority to issue licenses and regulations, demarcate or identify the mining area, and retains responsibility for mining.

A government is responsible for environmental management and protection through regulation, major environmental policies at the national level, managing mining resources, and ensuring that environmental laws are enforced by public and private entities. A government also prepares environmental standards, defines environmental policies, issues licenses to limit the volume or concentration of pollutants discharged into the environment, monitors potential environmental damage, and applies fines when laws are violated.

In some countries, national (federal) agencies are responsible for these activities. In others, responsibilities may be delegated to lower administrative levels. National (federal), state, provincial, and local (municipal) governments have different powers, and their specific roles and responsibilities can vary widely. For example, national governments tend to develop and formulate policies, and lower levels of government often implement those policies. National governments enact national legislation and regulations, and local levels of government use tools, such as permits and licenses. These are not fixed rules, however, so it is important for auditors to understand where an issue fits into the hierarchy, which level of government is involved, and how that level is involved.

Non-government organizations, such as civil institutions, members of social movements, professional associations, local communities, non-governmental organizations, business sectors, academic institutions, and scientific institutes, may have a role to play. In some countries, it is also important to highlight the key role played by indigenous communities. Many countries have established knowledge resource centers, databases, and networks to preserve and disseminate traditional ecological knowledge.

International financial institutions and their environmental requirements

The international financial institutions that pay more attention to environmental issues are the one of the major new trends spurring the development of international environmental standards for mining. Increasingly, multilateral development banks, multilateral and bilateral development assistance agencies, and other public and private finance and insurance institutions are conditioning their loans, aid, underwriting and other involvement on the target project's (and host country's) environmental acceptability, particularly with regard to mining projects.

This "green conditionality" comes in two forms

- the use of EIAs to screen projects in advance of approval and, to a lesser extent so far,
- actual operating conditions and requirements imposed on projects to promote sustainable development.

International financial institutions have been criticised for supporting environmentally destructive and unsustainable projects and have been embarrassed by several recent disasters at mines they have financed in developing countries. In addition, the institutions' new sustainable development requirements are also influencing progressive changes in the national law requirements of resource-based economies.

KEY QUESTION: What is the level of public expenditure for different policy instrument responses?

Enforcement

Traditionally, a mining or an environmental inspectorate has been charged with monitoring and enforcement. In countries with a federal government structure, it is common for enforcement to be delegated to provincial (state) or local government. While the central government maintains the overall control and management of the project, the regional government, which is often more in touch with the local situation, is responsible for the day-to-day monitoring and direct liaison with the company and local community.

Some countries have elected to place a full-time enforcement officer at each major project who, with proper training, can work closely with the company to ensure compliance while improving cooperation and consultation with all levels of government and the local community. Others have deliberately rotated officers to keep them from becoming too close to company management.

Whatever arrangement is adopted, compliance with environmental standards and legislation may be ensured by mechanisms such as imposing civil liability on mining operators, compulsory insurance or payment into a guarantee fund to pay for damages and compensation, financial surety, and incentive measures to maintain social and environmental standards in the absence of specific regulations. All these measures require some degree of inspection and enforcement by the competent authorities, and fines or sanctions of sufficient importance to discourage non-compliance. Government agencies are also starting to use consulting services in enforcement. In Western Australia, for example, evaluation of the assessment reports is now being handled by accredited assessors rather than by the government agencies directly.

A key new role for the agencies is now checking the credentials of assessors. In addition, there are calls from some quarters for independent roles in enforcement that could be taken up by NGOs.

Litigation

Depending on national laws, litigation is available to individuals acting alone or in a class action, to private organizations, and to governments. Lawsuits can take many forms, including private-versus-private litigation (for example, where industrial activity imposes 'unreasonable' costs on neighbouring communities); government-versus-private litigation, as a means of enforcing statutory obligations; and private-versus-government action, in which individuals or groups seek a judicial order to compel a government to act in accordance with its constitutional or statutory duties (though this does not apply to all countries). In addition, in some countries courts can help to clarify responsibilities on, for example, whether a particular level of government has the authority to address a particular issue.

In many countries, even where claimants have serious, valid complaints as a result of environmental, health, or human rights aspects of mining activities, their national court systems do not necessarily afford them clear or speedy remedies.

STEP 3: CHOOSE AUDIT TOPICS AND PRIORITIES

The important thing is to define the focus of the audit examination. Step 3 includes detailed information (including possible audit criteria, players, and researchable questions) on the following possible audit topics

- general environmental impact,
- potential water pollutants,
- possible air contaminants, and
- other pollution impacts.

It is up to the SAI to choose the audit topic and set priorities, which would answer the following questions:

KEY QUESTION: What are the risks relating to the environment and government's commitment?

The SAI will need to carry out a risk analysis in order to determine whether its action will be appropriate and useful. When assessing threats to the environment caused by mining, the auditor should consider the quantum of the actual and potential impact on the environment, society, and the economy.

When ascertaining the damage to the environment, the auditor should question how reversible that damage is. Irreversible damage is especially risky. Furthermore, the auditor should consider how intensive the damage is, because it is a priority to address and prevent acute threats. Generally, auditors rely on their government's assessments. Nevertheless, if needs arise, they may ask assistance from experts in the field.

It is also important for the auditor to examine the government's response regarding the identified environmental threats and its capacity to meet targets. The auditor should also consider the government's behavior in terms of abiding by the principles.

KEY QUESTION: Can an audit make a difference?

SAI will also have to assess where it will be most effective in improving the way the government protects and conserves the environmental in mining areas. The auditor may consider the following questions:

- What are the interests of the users of the audit report, particularly the primary users (e.g. parliament)?
- What is the relative significance of the topic to overall government activities?
- What is the impact of the audit likely to be? Is the audit likely to make a significant difference?
- Has mining been audited before?

KEY QUESTION: How will the institutional audit framework influence possible audit topics? Will the reporting requirement influence the choice of the audit topic?

An SAI will also need to ascertain where it will be most effective in improving the way the government protects the environment in terms of minerals processing and mining. The auditor may consider the following questions:

- What are the interests of the users of the audit report, particularly the primary users (e.g. Parliament)?
- What is the importance of the topic to overall government activities?
- What is the impact of the audit likely to be? Is the audit likely to make a significant difference?
- Has the topic been audited before?
- What is the relevance of this topic to protecting basic human needs?

KEY QUESTION: Does the SAI have the required mandate and authority?

After identifying the players, the SAI should determine which one has jurisdiction over the topical selected. The government may be able to act only at one particular level. For example, in Canada, for most cases, management of mining is delegated to the provinces and strong emphasis is placed on decentralized management. Private players (for instance), the private sector, state-run enterprises, or NGOs) that are financed by public resources may also fall under the SAI's jurisdiction where the SAI has mandate to follow money.

In spite of the lack of jurisdiction over some players, the auditor must know who they are and what role they play, since the government can regulate or influence their behavior through public policy tools and instruments. If the most influential players are not subject to the SAI's jurisdiction, auditing the issue may have little value.

KEY QUESTION: Are the topics auditable?

First and foremost, the auditor should consider and decide whether there are suitable sources of criteria against which to conduct the audit.

- Has the government signed international agreements relating to mining and processing minerals, and implemented the international obligations in its country?
- Has the government enacted laws and regulations in relation to mining and minerals activities?
- Has the government made policy statements on the issue?
- Are environmental threats caused by minerals and mining included in national budgets?
- Does the government receive external funding from international organizations?

After determining where their action will be most useful and choosing the topic, auditors can start planning the audit.

STEP 4: DECIDE ON AUDIT APPROACHES (SCOPING THE AUDIT)

Step 4 is the last step. For this last step, the auditor needs to select an audit approach and choose audit objectives, audit criteria, lines of enquiry and methodology for the audit. Normally governments have a variety of legal powers and tools that they can use to address environmental problems and activities. Legal powers include legislation (acts of parliament or congress), regulations, permits, licenses, bylaws, and ordinances. Governments have different roles and responsibilities over the whole mining process, including environmental issues associated with mining.

The standards applied to the conduct of audits looking at environmental issues for mining and minerals activities should be no different than any other audit. An environmental audit of mining will require the usual four phases of any audit - planning, field work, reporting and follow up. The essential objectives of making a difference, and promoting accountability and best practice remain unchanged.

A successful audit will often revolve around some basic questions of management.

- Is there anyone in charge?
- Is there adequate planning that includes mile stones, performance measures, goals and expected results?
- Does the organization have sufficient expertise at hand to discharge the responsibilities it is charged with?
- How well are the various organizations working together?
- Is accountability clearly defined? Is reporting clear, relevant, understandable and timely, does it include results?
- Is there adequate measurement of results against goals and targets?
- Is the relevant information being used to make sound decisions?
- Does the organization have adequate arrangements in place to asses how effective their actions are, and if so, what the results have been?

The following are some possible lines of enquiry and associated researchable questions. See Exhibit 3-2 for an overview diagram on how auditors can combine various topics and approaches.

Financial management and regularity

Using traditional financial audit techniques, auditors can investigate the use of public funds in projects and programmes that focus on conservation of the environment in relation to minerals and mining.

Are the funds spent on environmental conservation in relation to minerals and mining programmes correctly administered, according to spending authorities and regulations?

- Are adequate financial resources allocated to protection programmes?

- Is the disbursement of funds monitored?
- Against what criteria is the disbursement of funds measured?
- Do official trade-offs exist in policies? If so, how do the estimated benefits balance against the losses in environmental conservations caused by minerals and mining?

Compliance with agreements, laws, and policies

An audit of environmental conservation in relation to processing minerals and mining can address the consistency of government strategies, actions, and programmes with laws and regulations, or with the international conventions, to which the country is a signatory. It may answer the question: Is the government meeting commitments it made in treaties, laws, policies and programmes? The following are some lines of enquiry.

- Are there international agreements that protect the environment against the environmental threats caused by processing minerals and mining within the country?
- Is the country following the rules and agreements determined by the international conventions that it is a signatory to?
- Has the government enacted laws and regulations to implement its international commitments and domestic policies?
- Are there any conflicts or gaps between national policies on environmental conservation against processing minerals and mining and the country's environmental laws?
- Are environmental laws and regulations being adequately enforced?
- Is there any conflict between national policies and the international conventions that the country is a signatory to?

Compliance with national and international obligations

International agreements and conventions on mining are important instruments when it comes to preventing damage to the environment: It is therefore imperative that SAIs keep parliamentarians informed of how well executive governments fulfill their international obligations in this respect. In its most basic form, the audit of compliance with international obligations can address whether the government is ensuring that the international obligations ratified by the country are fully implemented in national laws and regulations.

Furthermore, it is important to evaluate how effectively the obligations are fulfilled and whether required measurement and reporting systems are in place and providing correct and timely information. The audit of international obligations is an area in which it is especially useful for SAIs to co-operate. Such co-operation might yield economies of scale because SAIs can help each other in the formulation of good audit questions and the collection of background information. It might also be useful for countries – and for the environment – to get an unbiased view of how well a participant is performing relative to other participants or to a group of such countries.

Policy

Auditing the impact of policies and programmes on environmental conservation against the environmental threats inherent in processing minerals and mining can be valuable. Interesting lines of enquiry include:

- Are government policies being complied with?
- Has the government developed policies that address the environmental pollutions caused by mining sector in the country?
- Do the policies deal with the most important threats?
- Have general policies on minerals and mining and environmental conservations been addressed, specified and executed in laws and other legal instruments such as plans and budgets?
- What kinds of changes can be suggested that would make national policies achieve better results?
- Are government programmes efficient?

Performance measurement and results (agencies and government programmes)

Audits of environmental conservation for processing minerals and mining can assess the performance of government programme's actions to deal with threats to, and ensure the conservation of, the environment. SAIs may wish to evaluate the traditional three "E"s – effectiveness, efficiency, and economy – of the programmes. They may also wish to assess the processes used to define and measure success and the results of these processes. Such assessments can be achieved by answering the following questions:

- Have the relevant agencies defined expected results for their programmes?
- Have they developed indicators and measures for the results and are the indicators and measures being monitored and tracked?
- Is the data used to measure performance reliable?
- Are the policies and programmes on environmental conservation for processing minerals and mining achieving their objectives and intended results?
- Why are policies and programmes not achieving their objectives and intended results, and how can the causes be countered?

Public education

National and international environmental protection programmes often have a public education component. Large sums of money can be spent even though the success of these programmes has not been measured. SAIs can include, among others, the following lines of enquiry:

- Is the government allocating appropriate funds for public outreach and education at each phase (formulation, planning implementation, and evaluation) of a policy?

- Is the government encouraging the public and private sector to protect the environment against unmanageable mineral processing and mining in terms of polluting the environment?
- Has the government integrated the mineral processing and mining environmental concerns into its public out-reach strategies?
- Is the government measuring its public outreach results?

Accountability, coordination and capacity

Because environmental conservation topics cut across many government entities and other players, SAIs could assess how departments and agencies have demonstrated good governance. For instance, whether they can meet their responsibilities for environmental programmes and actions, and whether they have mechanisms to coordinate those actions. The assessment can be achieved through answering the following questions.

- Are the roles, responsibilities, and accountability of relevant entities (for example, ministries and departments) clearly defined?[17]
- Are all necessary mechanisms to coordinate action in place?
- Do the entities have adequate financial and human resources to carry out their roles and responsibilities?
- Have the entities developed robust internal management system?

Scientific research and monitoring

The government's capacity to undertake research and monitor the level of pollution in the air; water; land degradation and human health effects from minerals and mining activities ought to be examined. In many countries this responsibility is legally defined. The following are suggested lines of enquiry.

- Does the government have the scientific knowledge (in-house or consultant-based) to prioritize its action on the threats to the environment resulting from processing minerals and mining?
- Are there adequate systems in place to monitor the status of levels of pollutants in the air, water, land and human health as a result of processing minerals and mining?
- Is the government developing and maintaining databases on mining's environmental effects either in house or with research Institutions?
- Is information shared between the national and international monitoring systems?
- Does the public have access to information on monitoring activities?

Reporting

The reporting requirements of public policies can be an important source of audit evidence. For example, many international environmental agreements require that national governments report to United Nations agencies or other international agencies (e.g. donor agencies). In addition, regulated entities within a country may be required to report to regulatory agencies that in turn, may report to their Parliament or equivalent.

Proper monitoring, reporting and accountability processes – which include collecting data, performing analysis and reporting findings – should be in place. SAIs can ensure that such reports and performance comply with appropriate standards, rules, and regulations. SAIs may consider:

- How are departments and agencies reporting their results?
- Are departments and agencies meeting international and national reporting obligations?

Summary of audit approaches

Exhibit 3-3 summarizes the many possible ways auditors can combine mineral processing and mining environmental topics and audit approaches. An environmental audit of mineral processing and mining may cover more than one of the listed topics and more than one audit approach can be used for each audit topic.

EXHIBIT 3-3: ENVIRONMENTAL AUDIT TOPICS AND APPROACHES TOPICS (MINING AND MINERAL PROCESSING)

	AUDIT APPROACHES (LINES OF ENQUIRY)					
	FINANCIAL MANAGEMENT AND REGULARITY	COMPLIANCE: AGREEMENTS, LAWS AND POLICIES	POLICY	PERFORMANCE MEASUREMENT AND RESULTS	ACCOUNTABILITY, COORDINATION AND CAPACITY	SIENCE RESEARCH AND MONITORING
General environmental impacts						
Possible air or soil contaminants						
Potential water problems /pollutants						
Other pollution impacts						

[17] Refer to Step 2 on key players.

Chapter 4:
Audits on mining activities

To facilitate the planning of an audit on mining and processing minerals, it may be useful to see how other SAIs have approached the field. This chapter therefore presents a set of examples of audits that reveal the most pressing problems related to mining that have confronted a number of SAIs.

Exibit 4-1

The SAI of Indonesia's audit on coal mining

Audit objectives

To assess whether:

- Internal control systems of coal mining management were adequate;
- Government institutions and mining companies comply with rules and laws regarding legal mining licenses, non-tax state income, fund sharing, and local government income.
- Mining companies comply with mining and environment laws and regulations.

Audit scope (lines of enquiries and audit methods)

The audit applied the following approaches:

- Risk-based audit focusing on high-risk aspects, such as coal mining policy, compliance to mining licenses, management of Non-Tax State Revenues (PNBP), and also environmental management in coal mining sector.
- Risks identified were then evaluated by reviewing the effectiveness of management, including system effectiveness, internal controls of governments and mining companies. Residual risks were used in determining samples of business unit and mine locations.
- Review of regulation and policy related to coal mining management. The regulations include policy and regulation of Central Government, Provincial Government and Regional Government.

Audit criteria

(1) Fundamental Rules of Mining; (2) Financial balance; (3) Non-tax incomes in Ministry of Energy and Natural Resources; (4) Division of Works between Central and Local Governments: (5) Analysis of Environmental Impacts; (6) Quality of Water and Control of Water Contamination; (7) Management of Toxic and Dangerous Waste Materials; (8) The Control of Air Contamination; and (9) Presidential Decree regarding Permit or Agreement in Mining Area inside the Forest Area.

Audit findings and recommendations

Policy weaknesses: The policy determination of estimated general mining income in State Budget Law and in a Budget Realization Report for the Minister of Energy and Mineral Resources (for the 2007 financial year) was not appropriate.

Non-compliance with laws and regulations: Mining companies have operated in forest areas without the necessary permits from the Ministry of Forestry.

Non-compliance with non-tax revenue income laws: mining companies paid lower than required fixed fees of Rp22.5 billion, lower coal royalty of Rp225 billion and US$6.95 million.

Non-compliance with environmental laws: Inappropriate manage-ment of top soils, sub-soils, toxic wastes and acid water waste.

Exibit 4-2
The SAI of Indonesia's audit on tin mining

Audit objectives
To ensure that:
- Government and mining companies maintain adequate control systems to minimize environmental damage
- mining companies (PT. Timah Tbk and PT. Kobatin) obey mining rules and meet their contractual obligations under the supervision of the Government of Indonesia
- the mining companies meet their Non-Tax State Revenues (PNBP) obligations.

Audit criteria
Law Number 11 of 1967 regarding Mining Rules, Law Number 20 of 1997 regarding PNBP, and Law Number 23 of 1997 regarding Environmental Management, and other rules about mining and standard operational procedures.

Audit method
The audit assessed budget expenditure and internal control systems, as well as the disclosure of financial and environmental processes.

Risk: The implementation method was based on reviewing and examining the effectiveness of the internal control system. The result influences the reliability of internal control system level according to the laws, and finally guides in determining audit object.

Materiality: The audit applies low level of materiality considering that user will give attention on legality and lawfulness on mining's rules. Besides that, materiality on environment management refers to important effects resulted from mine business according to the Environmental Impact Assessment.

Audit sampling: The three methods used to collect the audit evidence were:
- Interview and observation
- Testing samples
- Document review.

However, the SAI of Indonesia limited the audit analysis, especially on substantive testing with no further technical testing concerned with criteria.

Audit scope
Ministry of Energy and mineral resources, two tin mining companies (PT. Timah Tbk and PT. Koba Tin), and other related institutions.

Audit findings and recommendations
Both companies failed to conduct appropriate reclamation efforts on some mining areas/sites.
The SAI of Indonesia recommended that:
- the companies immediately design a comprehensive strategic plan that includes solutions for illegal mining practices, and involve the community, Government, and local authority;
- the PT Timah, Tbk mining company collect data on all its former mine sites and conduct reclamation;
- the companies realize their environmental commitments in keeping with environmental laws and the interests of society and Government;
- the Minister of ESDM sanction PT Timah Tbk for unpaid land rents, according to the Law and to revise the schedule of land rent payments;
- Company management pay the outstanding money owed (responsibility, royalty and land rent payments).

Exibit 4.3.

The SAI of South African's audit on rehabilitation of abandoned mines

The audit office conducted a performance audit on the rehabilitation of abandoned mines by the department of minerals and energy to determine whether the processes followed by the department of minerals and energy ensured the timely and cost effective identification and rehabilitation of abandoned mines to minimize adverse social and environmental impacts.

Audit objectives

The audit objectives were; to confirm whether the processes performed by the department of minerals and energy adhered to the following

- Quality reporting based on Integrated information system to record and report on the status of mines
- Governance arrangements whether were overmanned by Policies and procedures on budgeting for rehabilitation projects
- Leadership oversight whether comprised Strategic or business plan for the rehabilitation of abandoned mines

Audit scope

The audit examined the management of abandoned mining under the jurisdiction of the department of minerals and energy.

Audit criteria

Minerals and Petroleum Resources Development Act, 2002

Audit findings and recommendations

The department of minerals and energy did not have an approved national strategy for the rehabilitation of abandoned mines. Although the DME's overall strategic plan included high-level targets, detailed rehabilitation objectives were, in the absence of a national strategy, not clearly defined or linked to set time frames, priorities and responsibilities.

The DME also did not have the capacity, system or funds to ensure that any changes in the status of mines and abandoned mines would be updated on the database. The organizational structure of the DME did not support the objectives of the department for the rehabilitation of abandoned mines. The DME did not have the capacity to take an active part in decision-making, monitoring and site inspections in respect of the rehabilitation projects.

The DME did not have any policies or procedures for the allocation of funds to the committed list of rehabilitation projects at abandoned mines. As a result, funds were allocated on an ad hoc basis per project based on the funds available.

There were no communication policies or procedures for the rehabilitation of abandoned mines and no formal external communication channels existed. Internal and external communication.

Recommendation

The DME should ensure that the national strategy is approved and implemented. A business plan should be drafted with realistic, clearly defined objectives that are linked to specific time frames and responsibilities. The business plan should take the prioritisation of high-risk rehabilitation projects into account.

An integrated system for recording and reporting on the status of abandoned mines should be established. Measures should be instituted to monitor the activities of active and inactive mines in good time and to ensure that the database and the potential liability are updated accordingly.

The DME should institute measures to ensure the effective evaluation and adjudication of tenders and the timely appointment of contractors. Tender processes involving unsuccessful tenders should be re-evaluated and adjusted for subsequent tenders to ensure a successful process the second time around.

The DME should formalise communication channels with internal and external stakeholders involved in the rehabilitation of abandoned mines in a way that would promote accountability and service delivery. An interdepartmental project steering committee should be established for all rehabilitation projects to monitor the projects and take corrective action if and when required.

Exibit 4.4.
SAI Canada - Audit of Abandoned Mines In the North

Focus of the audit
The audit focused on examining the progress that Indian and Northern Affairs Canada has achieved in managing northern abandoned mines over the last several years through its Northern Affairs Program. The audit covers hard-rock mining only, which is mining that extracts the mineral from solid rock by drilling or blasting.

Objectives
The objective of the audit was to determine the progress the federal government has made in the last several years in managing contaminated sites resulting from abandoned mines in northern Canada including the Yukon, the Northern West Territories, and Nunavut.

The main audit objective was broken down into two sub-objectives, as follows:
- Determine the extent to which the federal government has identified abandoned mines, completed site assessments, set priorities for funding, selected and implemented site remediation options, and contained the risks posed by these sites.
- Determine whether the federal government has the necessary structures, resources, safeguards, and policies to effectively manage these sites and any future sites that it might inherit.

Scope and approach
The audit examined the management by Indian and Northern Affairs Canada of abandoned hard- rock mines in northern Canada. The auditors chose four mines to examine in detail. These four mines represent a significant portion of environmental liabilities in the region.

Auditors interviewed department officials and took detailed notes and photographs during site visits.

Criteria
In conducting the audit, the auditors looked for:
- consistent principles, practices, and standards for conducting environmental liability assessments for abandoned mines
- estimated environmental costs, liabilities, and risk associated with these sites and priorities for further assessment or remediation,
- a system for establishing priorities and contaminated sites management program,
- inspections to ensure that water license terms and conditions are adequately enforced,
- Comprehensive plans for the reclamation of disturbed areas, including the provision of satisfactory financial assurance to cover the costs of reclamation and, where necessary, long-term maintenance.

Main findings
The Department did not collect sufficient financial security from mining companies operating in the North to cover the costs for the eventual cleanup and closure of mine sites. Before 1993, there were legislated limits to the amount of financial security that could be collected. These restrictions were removed in 1993. Since then, Indian and Northern Affairs Canada has progressively increased the amount of financial security required from owners of operating mines in the North. Its objective is to obtain full financial security for all mining projects.

Main conclusions
The current situation of abandoned mines in the North demonstrates the importance of integrating the social, economic, and environmental dimensions of development. Indian and Northern Affairs Canada is now tasked with managing serious environmental problems but lacks the necessary long-term, stable funding. The handling of this situation is far from a good example of “environmental excellence,” a goal that the federal government set for itself in the 1999 Speech from the Throne.

Recommendations
Indian and Northern Affairs Canada should secure adequate resources to implement long-term solutions. Indian and Northern Affairs Canada should conduct the cleanup, containment, and closure of abandoned mines, based on priorities should put in place its management framework and long-term management plan for contaminated sites and abandoned mines in the North. The full report is available electronically at www.oag-bvg.gc.ca

Exibit 4-5

US GAO: Audit on Mine Safety- Better Oversight and Coordination by Mine Safety and Health Administration (MSHA) and Other Federal Agencies in Improving Safety for Underground Coal Miners

The GAO examined the challenges underground coal mines face in preparing for emergencies, how well MSHA oversees mine operators' training efforts, how well MSHA and National Institute for occupational safety and Health (NIOSH) coordinate to enhance the development and approval of mine safety technology, and how civil penalties are assessed. To address these issues, GAO surveyed a representative sample of active underground coal mines, analyzed agency data, conducted site visits, and talked with agency officials and other experts. The survey results are estimated at the 95 percent confidence level.

Audit objectives

- Examine the challenges underground coal mines face in preparing for emergencies.
- Examine how well the Mine Safety and Health Administration oversees mine operators' training efforts.
- Examine how well Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (NIOSH) coordinate to enhance the development and approval of mine safety technology.
- Examine how civil penalties are assessed.

Scope of the audit

Auditee(s): The Mine Safety and Health Administration (MSHA), the National Institute for Occupational Safety and Health (NIOSH), the Federal Mine Safety and Health Review Commission, the Department of Labor's Office of the Solicitor, the states, and the mining industry share responsibility for ensuring mine safety.

Main findings

Mine operators have limited access to special training facilities, and limited capacity to pay for training. MSHA has materials for providing specific hands-on training for mine emergencies. MSHA has materials for providing specific hands-on training for mine emergencies, but it does not provide all mine operators with information and tools for training under simulated emergency conditions. Between 1996 and 2006, MSHA proposed assessing mine operators' 506,707 penalties for violations of underground coal mine safety and health standards.

Main conclusions

Underground coal mine operators face significant challenges preparing for emergencies, including ensuring that miners receive realistic training and organizing mine rescue teams that satisfy new requirements. Coordination between MSHA and NIOSH is largely informal and inconsistent. Without a more structured method of coordination, MSHA and NIOSH cannot use their shared knowledge base and research to effectively hasten the implementation of new safety technology in mines.

Recommendations

To help mines train their workers under simulated emergency conditions, the Secretary of Labor should direct MSHA to publicize information and available tools for training mine workers under such conditions. In addition, MSHA should periodically review and update this information, as appropriate. In order to ensure that there is transparency in penalty determinations, we recommend that the Department of Labor's Office of the Solicitor, MSHA, and the Commission take steps to ensure that the specific rationale for all final penalty amounts, including reductions from MSHA's proposed penalties, are adequately documented.

The full report is available electronically at www.gao.gov.

Exibit 4-6

SAI of China: Performance Audit Investigation upon the Control and Comprehensive Utilization of Gangue/mineral ore

Background

The audit office of China conducted a study as part of a project to develop "Guidelines for Auditing Mineral Resources". The report of the performance audit into the control and comprehensive use of mineral ores was produced in 2008.

Audit objectives

Assessing the performance of control and comprehensive use work for mineral ores. Boosting local governments to intensify the efforts of utilizing gangue in a comprehensive way; Urging local governments to strengthen environmental protection, and advancing the sustainable development of the local economy and ecosystems.

Criteria

Promoting the effective implementation of national comprehensive utilization policy for gangue.

Evidence/finding

- Relatively low utilization ratio of gangue, only for limited purposes and low level of comprehensive utilization;
- Wall materials are mainly composed of clay bricks which are not conducive to the effective protection of arable land, energy conservation and eco-system improvement;
- Relevant basic information is not complete, statistic data is yet to be integrated and comprehensive utilization should be further improved.

Overall conclusions

Coal Industry Group has altogether provided financial support of 84.23 million RMB for controlling gangue-piled hills ever since 2004 and made obvious effects.

At the time of the audit, there had been no spontaneous combustion by gangue-piled hills, new-generated gangue had been fully discharged according to the new discharge rules, and most of old gangue-piled hills had been rectified.

Gangue-fired power-generating and brick-making projects have been put into operation and initial benefits have been shown.

Recommendations

Clearly-defined laws, rules and standards for discharging and controlling gangue should be promulgated so that enterprises could be promoted to strictly abide by the relevant regulations for controlling the piling of gangue and control the environmental impacts of gangue-piled hills to the maximum.

Government input for controlling the gangue-caused disaster should be increased. Otherwise the rectification of gangue-piled hills is mainly relying on the financial resources of coal industry and the relevant enterprises are heavily burdened. The increase of government input shall further mobilize the enterprises to control and comprehensively utilize gangue.

Support policies and measures should be put into place in order to solve the problems such as low level of comprehensive utilization of gangue, backward technical facilities, small-scale production, poor competitive power and limited potential for further development.

The national preferential policies should be fully implemented in order to mobilize the initiatives of various parties to control and rectify gangue-piled hills. For example, various policy limits with regard to approving and giving loans to the projects of gangue-fired power plant, giving the right to be combined to the grid, price of electricity and peak load regulating operation should be lifted. More preferential policies should be given. Moreover, the policy support to the technology and industry in the field of cyclic operation of gangue should be increased. The development and promotion of gangue-utilization projects should be quickened.

Exibit 4-7

US GAO: Hard rock Mining: Bureau of Land Management (BLM) Needs to Better Manage Financial Assurances to Guarantee Coverage of Reclamation Costs

Audit objectives

Determine the types, amount, and coverage of financial assurance operators currently use. Determine the extent to which financial assurance providers and others have paid to reclaim land not reclaimed by the operator since BLM began requiring financial assurances. Determine the reliability and sufficiency of BLM's automated information system (LR2000) for managing financial assurances for hardrock operations.

Main findings

According to GAO's survey of BLM state offices, as of July 2004, hardrock operators were using 11 types of financial assurances, valued at about $837 million, to guarantee reclamation costs for existing hardrock operations on BLM land. Surety bonds, letters of credit, and corporate guarantees accounted for most of the assurances' value. BLM identified 48 hardrock operations on BLM land that had ceased and not been reclaimed by operators since it began requiring financial assurances. BLM reported that, as of July 2004, some existing hardrock operations do not have financial assurances and some have no or outdated reclamation plans and/or cost estimates, on which financial assurances should be based. Some operations did not have financial assurances, despite BLM efforts in some cases to make the operators provide them. Some operations' financial assurances were less than the most recent reclamation cost estimates. Some financial assurance providers went bankrupt. LR2000 does not track the status of hardrock operations, whether each existing operation that requires a financial assurance has the assurance, and whether the financial assurance is adequate to pay the cost of required reclamation.

Main conclusions

BLM's LR2000 is not reliable and sufficient for managing financial assurances for hardrock operations because BLM staff do not always update information and LR2000 is not currently designed to track certain critical information.

Having adequate financial assurances to pay reclamation costs for BLM land disturbed by hardrock operations is critical to ensuring that the land is reclaimed if operators fail to complete reclamation as required.

Financial assurances must be based on sound reclamation plans and current cost estimates so that BLM can be confident that financial assurances will fully cover reclamation costs.

BLM does not have a process for ensuring that the regulations and guidance are effectively implemented to ensure that adequate financial assurances are actually in place, as required.

BLM does not know whether all hardrock operations have adequate financial assurances because of limitations in the types of information collected in the LR2000 and failure of staff to update information in a timely manner.

BLM has not ensured that some current and previous operators have adequate financial assurances, as required by federal regulations and/or BLM guidance.

Some operations either do not have any, or have outdated reclamation plans and/or cost estimates. When operators fail to reclaim land disturbed by hardrock operations, BLM is left with public land that requires tens of millions of dollars to reclaim or risk hazards posed to the environment and human health.

Main recommendation

To ensure that hard rock operations on BLM land have adequate financial assurances, we recommend that the Secretary of the Interior direct the Director of BLM to take the following two actions:

- Require the BLM state office directors to establish an action plan for ensuring that operators of hardrock operations have required financial assurances and that the financial assurances are based on sound reclamation plans and current cost estimates, so that they are adequate to pay all of the estimated costs of required reclamation if operators fail to complete the reclamation.
- Modify LR2000 to ensure that it tracks critical information on hardrock operations and associated financial assurances so that BLM headquarters and state offices can effectively manage financial Assurances nationwide to ensure regulatory requirements are met.

Exibit 4-8

US GAO: Natural Resource Management: Opportunities Exist to Enhance Federal Participation in Collaborative Efforts to Reduce Conflicts and Improve Natural Resource Conditions

Audit objectives

- Determine experts' views on collaborative resource management
- Determine how selected collaborative efforts have addressed conflicts and improved resources
- Determine challenges that agencies face as they participate in such efforts and how the Cooperative Conservation Initiative has addressed them.

Main findings

Experts view collaborative resource management involving public and private stakeholders as an effective approach to managing natural resources.

Most of the seven collaborative resource management efforts GAO studied in several states across the country were successful in achieving participation and cooperation among their members and improving natural resources conditions.

In six of the cases, those involved were able to reduce or avoid the kinds of conflicts that can arise when dealing with contentious natural resource problems.

All the efforts, particularly those that effectively reduced or avoided conflict, used at least several of the collaborative practices described by the experts.

Main conclusion

Collaborative resource management can result in reduced conflict and litigation and improved natural resource conditions. Seeking inclusive representation, establishing leadership, and identifying a common goal are commonly aspects of successful collaborative resource management.

Federal land and resource management agencies—the Department of the Interior's Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service, and the Department of Agriculture's Forest Service—face key challenges to participating in collaborative resource management efforts, according to the experts, federal officials, and participants in the efforts GAO studied.

Opportunities exist to develop and disseminate tools, examples, and guidance that further address the challenges. Collaboration provides groups a way to integrate multiple interests and achieve common goals.

Federal land and resource management agencies have to date had some success in working with collaborative efforts. The policies put in place through the Cooperative Conservation initiative move the federal government and agencies forward in supporting collaborative resource management efforts.

Agencies need to be judicious in their decisions about collaborating with particular efforts and could benefit from guidance on how this can be done.

Main recommendation

The Council on Environmental Quality, The Department of the Interior, and the Department of Agriculture should:

- Disseminate, more widely, tools for the agencies to use in assessing and determining if, when, and how to participate in a particular collaborative effort and how to sustain their participation over time.
- Identify examples of groups that have conducted natural resource monitoring, including at the landscape level, and develop and disseminate guidance or protocols for others to use in setting up such monitoring efforts.
- Hold periodic national or regional meetings and conferences to bring groups together to share collaborative experiences identify further challenges, and learn from the lessons of other collaborative groups.
- Identify goals, actions, responsible work groups and agencies, and time frames for carrying out the actions needed to implement the Cooperative Conservation initiative, including collaborative resource management, and document these through a written plan, memorandum of understanding, or other appropriate means.

Research case study on mining

The increased use of mercury in gold recovery in mining operations in developing countries in recent year has raised world concern over the release of this toxic metal into the environment. With this reason, the University of Dar es Salaam in Tanzania took the initiative of carrying out a study with the objective of determining mercury levels in fish, human hair and urine in order to asses environmental and human exposure to mercury.

This was a study undertaken by the University. The SAI of Tanzania took this study as one of the reliable sources of information to guide any auditor from different SAIs while carrying out an environmental audit on mining. Relevant information to guide the auditor is as follows.

Exibit 4-9

Case study: monitoring fish and human exposure to mercury due to gold mining in the Lake Victoria goldfield, Tanzania (University of Dar Es Salaam, Tanzania).

Audit objectives

Increased use of mercury in gold recovery in mining operations in many developing countries in recent years has raised world concern over the release of this toxic metal into the environment. Previous experiences of human mercury poisoning in Minamata Bay (1956) in Japan and in Iraq (1970s) indicate the dangers associated with mercury contamination. Little work, however, has been undertaken to study environmental mercury contamination in African countries where an increasing number of people are engaged in the so called “artisan” small scale gold mining using mercury amalgamation techniques. In Tanzania, for example, it is estimated that about 250,000 people are involved in small-scale gold mining in three principal gold fields, namely the Lake Victoria goldfields around Lake Victoria.

Risk

There is potential risk of human exposure to inorganic mercury because of the extensive use of mercury in gold recovery in the Tanzanian goldfields. Furthermore, inorganic mercury released into river systems during gold ore processing is likely to be gradually transformed into the highly toxic form of methyl mercury and become concentrated through biomagnifications in aquatic food chains, particularly in fish consumed by local populations.

Study objective

To determine mercury levels in fish and human hair and urine in order to assess environmental and human exposure to mercury in the Lake Victoria gold fields.

Scope

The Lake Victoria Gold Field (LVGF) refers to a number of goldfields located to the east and south of Lake Victoria in northern Tanzania. About 4.5 tonnes of mercury are released annually in the LVGF alone by gold mining activities .Two study areas, Mugusu and Nungwe Bay, were chosen for biological monitoring of mercury contamination.

Mugusu has been an active small scale gold mining area since 1988. Inhabitants of the Mugusu mine were chosen for monitoring of inorganic mercury exposure from amalgam burning. Nungwe Bay on the south western part of Lake Victoria is located about 10 Km from the Mugusu gold mine. The bay is essentially a drainage area for the Mugusu (Mabubi) river and other rivers contaminated with mercury due to gold mining activities. The bay is surrounded by a village (Nyamwilolelwa) whose inhabitants are engaged both in fishing and farming, and fish is a major item in their diet. Those inhabitants were thought to be suited for monitoring of organic mercury exposure through fish consumption. Fish from Nungwe Bay were considered to be ideal for monitoring of environmental mercury contamination in that area as fish could not be obtained from the contaminated rivers.

Methodology

Sampling was conducted during the first week of November 1995. Hair and urine samples were collected mainly from inhabitants of the Mugusu goldmine and Nungwe Bay fishing village. Hair samples were collected by cutting about 30–50 mg of hair close to the scalp. Each sample was preserved in a labelled paper envelope and kept in airtight plastic bags. Spot urine samples were collected in clean glass bottles with tight plastic caps.

Both hair and urine samples were kept at room temperature (25°C) for 4 days before the samples were transported from the field to the Geochemical Laboratory at the University of Dar es Salaam where they were kept in a freezer until the time of shipment to Japan for analysis.

Exibit 4-9 continued

Fish samples were collected from different types of fish caught from Nungwe Bay by fishermen during the day of sampling. Each fish sample consisted a rectangular piece (2x4 cm) of fish muscle. The samples were collected in thick polyethylene bottles with tight caps and kept in a cooler box until brought to the nearby town where the samples were frozen. All fish samples were transported and kept frozen until analyzed.

Mercury analysis: Samples were analyzed for total mercury (T – Hq) and methlymercury (mehg) at the National Institute for Minamata Disease (NIMD) in Japan.

Criteria
In conducting the study, the University Of Dar e salaam used the following criteria:-
- According to WHO environmental health criteria, mercury concentrations in fresh-water fish from non-polluted areas are commonly in the range of 100 – 200 ppb (0.1 – 0.2 Mg/g).
- The reference value for total mercury in hair is considered to be about 2000 pbb (2 ug/g; WHO).
- The urinary mercury level that increases the incidence of mercury toxic affects is considered to be above 50 ng/ml.

Results/findings
Monitoring of environmental and human exposure to mercury in the Nungwe Bay area of the Lake Victoria goldfields, Tanzania revealed the following:-
- Low mercury concentration in fish (range: 1.8 – 16.9 ppb, mean: 7.0 ppb);
- Human hair (range: 156 – 442 ppb, mean: 304 ppb)
- Urinary mercury levels in gold mine workers frequently exposed to mercury vapor in amalgamation and burning of amalgam were significantly higher (mean: 241 mg/ml) than in the general mine population not occupational exposed to mercury (Mean: 2.6 hg/ml.)

Recommendation
Rotation of mine duties (e.g. amalgamation or amalgam burning vs mining) reduced urinary mercury levels in the mine workers and hence reduced the risk of mercury intoxication.

Other audits on mining

Following audits were also provided to the authors of this paper through a questionnaire that was sent to the SAIs. For a more comprehensive list of audits of mining and mineral processing produced by SAIs, visit the WGEA website (www.environmental-auditing.org).

COUNTRY	AUDIT TITLE
Bhutan	Audit of Mining Control System
Canada	Annual Report on Environmental Petitions
Colombia	Environmental management of mining activities: carbon and gravel carment de carupa, cucunuba, guacheta and sutatausa municipalities
Equador	Environmental and Management Audit of the Petroproduccion Corporation in the Extraction and Production of Crude, Related to Drilling Fluids and Sludge and Formation Water, in the Provinces of Orellana and Sucumbios. Special Study of Controls Over Mining Operations in the Santa Rosa, Caluguro, Tenguel, and Siete Rivers Basins, which are the Responsibility of the Regional Gold Mining Directorate, the Ministry of the Environment, and the Ministry of Energy and Mines.
Estonia	Exploitation of Peat Resources
Honduras	Environment Audit Report by Mining Activities Pollution. Environmental Performance Audit to Mining Governmental Institution.
Indonesia	Audit on the Implementation of Environmental Impact Assessment in PT Chevron Pacific Indonesia. Audit of Environmental Impact Control in General Mining.
Paraguay	Exploitation of the Mineral Resources Handling by the Vice Ministry of Mines and Energies. Management of samples of radioactive substance by the vice ministry of mines and energies.
Poland	Observance of Requirements Related to Fees Collected for Licenses to Extract Selected Common Minerals.
Russia	Audit of the effective use of cement raw materials and observance of the nature protection legislation in the extraction process in the Ryazan area, and also uses of the federal budget funds by enforcement authorities. Performance audit of reproduction of a mineral-raw-material base of Russia in 2005-2007-2008.
US	Mineral Revenues: Cost and Revenue Information Needed to Compare Different Approaches for Collecting Federal Oil and Gas Royalties

Appendix 1:
Audit Design Matrix

The design matrix has different functions:

- A planning tool to support identification of the most relevant and feasible audit design
- A communication tool to describe the design to the board of the SAI, the government or others
- An efficiency tool to encourage systematic data collection and analysis
- An effective tool to ensure the connection between the expected audit findings (what the audit will enable the SAI to communicate), the criteria for and the design of the audit (researchable questions and methodology).

The design matrix may help to define the audit objectives, researchable questions, audit criteria, audit evidence, methods of collecting audit evidence, expected audit findings (risk areas). Step 4 in the guide describes examples covering the four first columns but developing a full-scale matrix during the planning stage is recommended.

Example of a design matrix – mining audit

Audit objective: What do we wish to achieve through the audit?

- The goal of the investigation is to assess the authorities' work on implementing the decisions of parliament concerning mining and minerals, and to show that unclear goals can prevent target achievement. The information in this appendix will provide possible ways in designing the audit, this example of design matrix covers various topics which can be audited in the area of mining such as financial management and regularity, compliance with agreements, laws, and policies, policy, Performance measurement and results (agencies and government programmes) and Public education

TOPIC	RISK	RESEARCHABLE QUESTION	SUB RESEACHABLE QUESTION	CRITERIA
Financial management and regularity	Funds set aside for the environmental conservation not utilized for this purpose (misallocation of fund)	Are the funds spent on environmental conservation in relation to minerals and mining programmes correctly administered? According to spending authorities and regulations?	Are adequate financial resources allocated to protection programmes? Is the disbursement of funds monitored? Against what criteria is the disbursement of funds measured? Do official trade-offs exist in policies? If so, how do the estimated benefits balance against the losses in environmental conservations caused by minerals and mining?	Eros Approved budget. Strategic plan. There should be budget allocation with regards to mining activities according to Strategic plan. Compliance with Environmental management plan ion damage and deforestation
Compliance with agreements, laws, and policies	Inadequate governance regime to protect the mining and minerals adverse impacts. Failure to meet the environmental commitments made in management and monitoring of mining and mineral activities. Inability to establish the legal frame work for establishing agreement on mining and mineral activities and collecting royalties from mining activities.	Are the government meeting commitments it made in treaties, laws, policies and programmes?	Are there international agreements that protect the environment against the environmental threats caused by processing minerals and mining within the country? Is the country following the rules and agreements determined by the international conventions that it is a signatory to? Has the government enacted laws and regulations to implement its international commitments and domestic policies? Are there any conflicts or gaps between national policies on environmental conservation against processing minerals and mining and the country's environmental laws? Are environmental laws and regulations being adequately enforced? Is there any conflict between national policies and the international conventions that the country is a signatory to?	International agreemts to govern the environmental threats caused by processing mining and minerals within a country. A country should be a signatory to relevant international conventions, treaties relating to mining and minerals.

TOPIC	RISK	RESEARCHABLE QUESTION	SUB RESEACHABLE QUESTION	CRITERIA
Policy	Uncontrolled mining and minerals activities	Do the policies and programs exist for conserving the environment against threat caused by processing mining and minerals?	Are government policies being complied with? Has the government developed policies that address the environmental pollutions caused by mining sector in the country? Do the policies deal with the most important threats? Have general policies on minerals and mining and environmental conservations been addressed, specified and executed in laws and other legal instruments such as plans and budgets? What kinds of changes can be suggested that would make national policies achieve better results? Are government programmes efficient?	Approved polices
Performance measurement and results (agencies and government programmes).	No control over performance programme as regards to dealing with threats caused by mining and minerals in the environment. In ability to determine the efficiency, effectiveness and economy of government programme.	Are assessment being done on government programs' in concerning environment as far as mining and mineral activities are concerned.	Have the relevant agencies defined expected results for their programmes? Have they developed indicators and measures for the results and are the indicators and measures being monitored and tracked? Is the data used to measure performance r eliable? Are the policies and programmes on environmental conservation for processing minerals and mining achieving their? Objectives and intended results? Why are policies and programmes not achieving their objectives and intended results, and how can the causes be countered?	Performance indicators stipulated in relevant mining regulations. Mitigation measures stipulated in environmental management plan. Best practices stipulated by ISO.
Public education	Destruction of environment due lack of awareness.	Are there public education programmes on protecting the environment.	Is the government allocating appropriate funds for public outreach and education at each phase (formulation, planning implementation, and evaluation) of a policy? Is the government encouraging the public and private sector to protect the environment against unmanageable mineral processing and mining in terms of polluting the environment? Has the government integrated the mineral processing and mining environmental concerns into its public outreach strategies? Is the government measuring its public outreach results?	Established degradation rate. Established baseline.
Accountability, coordination and capacity.	Poor performance and malfunctioning.	Are the funds spent on environmental conservation in relation to minerals and mining programmes correctly administered? According to spending authorities and regulations?	Are the roles, responsibilities, and accountability of relevant entities (for example, ministries and departments) clearly defined? Are all necessary mechanisms to coordinate action in place? Do the entities have adequate financial and human resources to carry out their roles and responsibilities? Have the entities developed robust internal management system?	Service charter. Organization structure.
Reporting to clients and the public.	Non accountability. No monitoring systems at the local government level appropriate and working well. Action on recommendation is not taken. Environmental issues not addressed. No performance evaluation.	Does the reporting mechanism exist.	How are departments and agencies reporting their results? Are departments and agencies meeting international and national reporting obligations?	International environmental agreement. Regulatory agencies and parliament.

Appendix 2: **Fundamental principles for the mining sector**

Berlin Guidelines 1991, revised 1999

Auditors should check whether government is a signatory to the said guideline for compliance.

Governments, mining companies and the minerals industries should as a minimum:

1. Recognise environmental management as a high priority, notably during the licensing process and through the development and implementation of environmental management systems. This should include early and comprehensive environmental impact assessments, pollution control and other preventive and mitigation measures, monitoring and auditing activities, and emergency response procedures.
2. Recognise the importance of socio-economic impact assessments and social planning in mining operations. Social-economic impacts should be taken into account at the earliest stages of project development. Gender issues should also be considered at a policy and project level. (New principle)
3. Establish environmental accountability in industry and government at the highest management and policy-making levels.
4. Encourage employees at all levels to recognise their responsibility for environmental management and ensure that adequate resources, staff and requisite training are available to implement environmental plans.
5. Ensure the participation of and dialogue with the affected community and other directly interested parties on the environmental and social aspects of all phases of mining activities and include the full participation of women and other marginalised groups. (Revised)
6. Adopt best practices to minimise environmental degradation, notably in the absence of specific environmental regulations.
7. Adopt environmentally sound technologies in all phases of mining activities and increase the emphasis on the transfer of appropriate technologies which mitigate environmental impacts including those from small-scale mining operations.
8. Seek to provide additional funds and innovative financial arrangements to improve environmental performance of existing mining operations.
9. Adopt risk analysis and risk management in the development of regulation and in the design, operation, and decommissioning of mining activities, including the handling and disposal of hazardous mining and other wastes.
10. Reinforce the infrastructure, information systems service, training and skills in environmental management in relation to mining activities.
11. Avoid the use of such environmental regulations that act as unnecessary barriers to trade and investment.
12. Recognise the linkages between ecology, socio-cultural conditions and human health and safety, the local community and the natural environment. (Revised)
13. Evaluate and adopt, wherever appropriate, economic and administrative instruments such as tax incentive policies to encourage the reduction of pollutant emissions and the introduction of innovative technology.
14. Explore the feasibility of reciprocal agreements to reduce transboundary pollution.
15. Encourage long term mining investment by having clear environmental standards with stable and predictable environmental criteria and procedures.

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