These Updates either replace or complement parts of the Environmental Assessment Sourcebook, published in 1991, as part of the World Bank Technical Papers Series, numbers 139, 140, and 154.
Environmental Assessment of Mining Projects

Expansion within the mining and metallurgical sector is central to the development and economic growth of many developing countries. The products of the sector (including metallic and non-metallic substances, construction materials or fertilizers) are not only essential to many industrial processes and for construction activities, but also are often a valuable source of foreign exchange earnings. However, mining operations frequently involve considerable environmental disturbance that can extend well beyond the area of mining developments.

The impacts of mining related activities commence with exploration, extend through extraction and processing of minerals, and may continue post-closure of the operation, with the nature and extent of impacts varying throughout the stages of project implementation. This Update provides an introduction to the environmental issues associated with mining activities, the relevant contexts where the Bank might be involved with mining projects, and the extent to which environmental issues should be addressed by private or public sector organizations seeking Bank Group support for mining projects. While this Update briefly mentions certain social impacts, the primary focus is on physical environmental issues. This Update complements material in Chapter 10, pages 179-194 of the Environmental Assessment Sourcebook.

Introduction

In comparison with many other sectors, the potential social and environmental issues associated with mining and mineral processing operations are both highly significant and complex to manage. The fixed location of the mineralized zone of interest imposes constraints on all aspects of mining developments, including the method of mining, location of mine facilities, requirements for new infrastructure and services (or conflict with existing infrastructure), and the suitability of waste management or disposal methods. This in turn profoundly influences the environmental, social and health impacts of mining developments, as well as the economic viability of developing a given mineralized zone.

The challenges posed to EA of mining projects are twofold. Firstly, to ensure that environmental, social and health costs are afforded 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 into project design, implementation and 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.

The International Conference on Development, Environment and Mining—jointly sponsored by the Bank, the International Council on Metals and the Environment (ICME), United Nations Environment Programme (UNEP) and the United Nations Conference on Trade and Development (UNCTAD)—held in Washington, D.C. in 1994 highlighted the following in relation to mining:

- Government approaches to environmental regulation are shifting from centralized decision making, detailed regulations, and command-and-control toward the setting of objectives, clear standards and provision of information.
- Environmental regulations do not act as a disincentive to investment, provided that the regulations are realistic, transparent and stable.
- Mining companies should take full account for social and cultural issues in promoting sustainable development.
Accordingly, the primary objectives of this Update are to:

- Provide Bank Group staff and borrowers with a brief overview of the environmental issues associated with mining and metallurgical processing
- Identify the types of Bank Group lending within the sector and describe the associated EA requirements (with reference to Bank policies and guidelines)
- Provide guidance on developing the institutional framework, and private sector environmental management capacity, to support sustainable development in the mining sector.

This Update is not intended as a detailed source of information on the environmental implications of the wide range of mining operations and project contexts. However, sources of such information are included on the last page of the Update.

Overview of environmental aspects of mining

Mining operations may generally be categorized as either surface or underground. Surface mining may be broadly defined to encompass open pit, open cast, quarry, strip, dredging, and placer (hydraulic) mining. Underground mining includes a range of methods such as cut-and-fill, pillar-and-stope, shrinkage stope, block caving, and longwall mining. Most mining operations (whether surface or underground) share a number of common stages or activities, each of which have potentially adverse impacts on the natural environment, social and cultural conditions, or the health and safety of mine workers, or communities in the environs of the mine. These adverse impacts may be especially severe when mining takes place in areas occupied or utilized by indigenous peoples. Mining and its related activities fall into the following categories:

- Exploration
- Extraction and disposal of waste rock, and so forth
- Ore processing and plantsite operations
- Tailings containment, treatment, and disposal
- Infrastructure, access, and energy
- Construction workcamps and operational townites.

The potential adverse impacts of each of these activities (including impacts on air quality, hydrology and water quality, ecology and biodiversity, social and cultural conditions, human health, natural resources, and infrastructure) are illustrated in a simplified matrix in box 1, and briefly discussed below.

The identification of the area (and communities) potentially affected by a mining project is a key initial task. While the most obvious impacts may occur in the immediate vicinity of the mine and waste dumps, ecosystems and communities far distant may be impacted in the case of riverine disposal of waste and by the transportation and shipment of ores and coal over long distances. Such factors need to be taken into consideration in determining the aerial extent of any environmental and social studies.

Mining EA teams must determine the range, type, and duration of baseline data needed to make defensible and robust impact predictions. Where baseline information is lacking, as is often the case in developing countries, it is important to gather such data to support impact prediction and assessment. Additional guidance on baseline data is given in Update no. 16: Challenges of Managing the EA Process.

Exploration activities

Exploration activities encompass all actions in the field which precede feasibility studies. This might 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 accommodations, and power generation for exploratory drilling. The potential environmental implications of exploration depend on a number of factors, notably the following:

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

The potential significance of the environmental and social disruption associated with exploration has often not been recognized, although experience suggests that this is increasingly the first point of conflict on many such issues. Exploration impacts may be controlled by measures such as restricting land clearance to the minimum required, removal or disabling of access infrastructure, use of helicopter access for personnel and equipment wherever practicable, developing plans for managing contact with local communities, and rehabilitation of abandoned exploration sites.

**Ore extraction and disposal of overburden and waste rock**

Overburden and waste rock include non-mineralized strata overlying or interleaving mineralized zones,