Topic 7

Mitigation and impact management

Introduction

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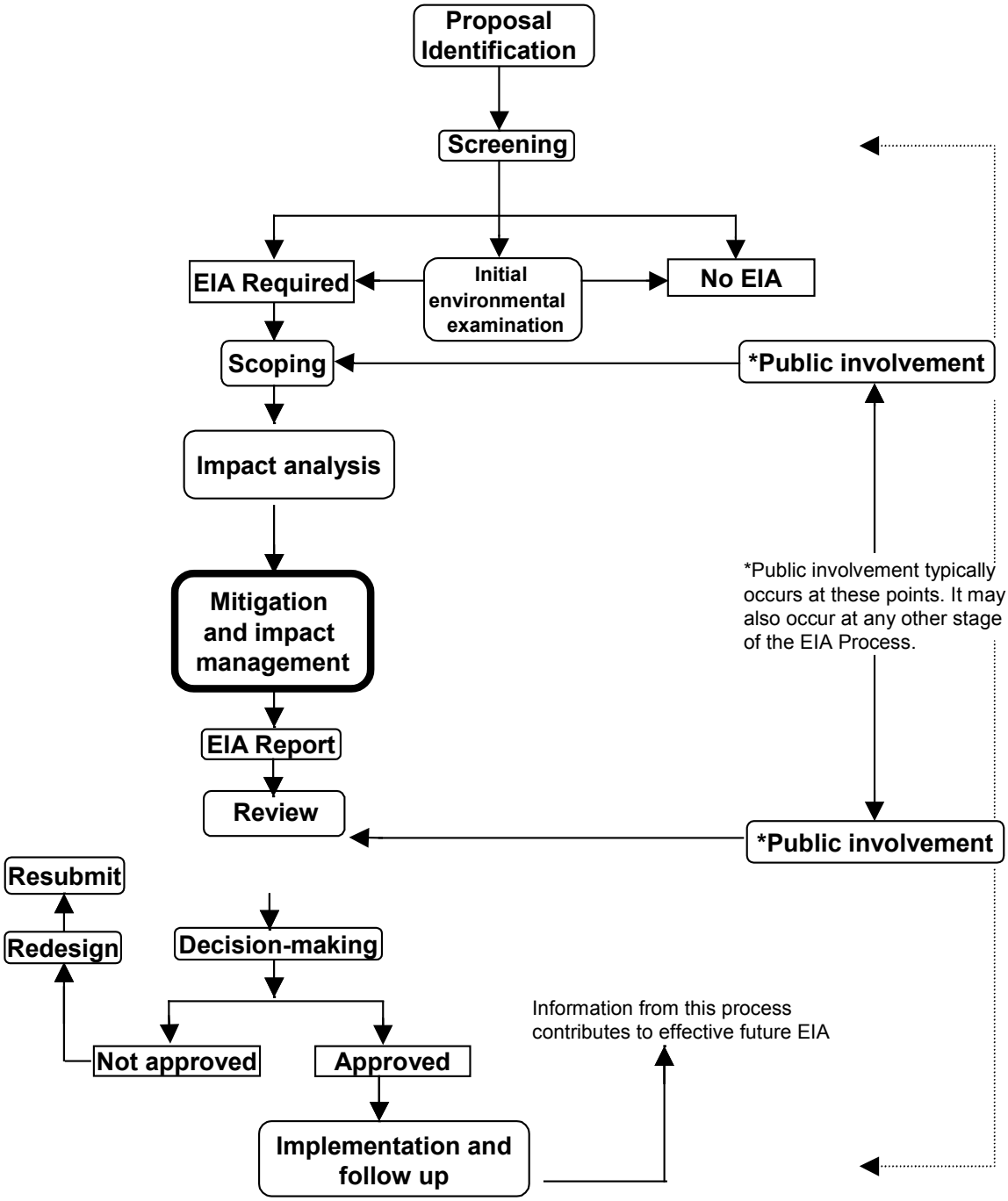
Mitigation and impact management



Topic 7—Mitigation and impact management

Objectives

To understand the role of mitigation in the EIA process and its importance for impact management.

To identify the principles, elements of approach and measures that are used for this purpose.

Relevance

Mitigation is the stage of the EIA process when measures are identified to avoid, minimise or remedy impacts. These measures are implemented as part of the process of impact management, together with any necessary adjustments to respond to unforeseen impacts. Both elements are integral to ensuring that the EIA process leads to practical action to offset the adverse environmental impacts of proposed developments.

Timing

Two hours (not including training activity)

Important note to trainers

You should design your presentation with the needs and background of participants in mind, and concentrate on those sections most relevant to your audience. The session presentation timings are indicative only.

Time taken for the training activities can vary enormously depending on the depth of treatment, the existing skills and knowledge of participants and the size of the group.

☑ Information checklist

Obtain or develop the following, as appropriate:

- ❑ EIA reports (preferably local) and associated approval conditions that have been used to generate and implement impact management plans;
- ❑ examples of the successful design and implementation of measures as a result of EIA;
- ❑ copies or results of any research focused on mitigation or impact management, and if possible relevant information from monitoring, audit and other follow up measures;
- ❑ contact names and telephone numbers of people, agencies, organizations and environmental information data resource centres able to provide assistance in mitigation or impact management; and
- ❑ other resources that may be available, such as courses in specific analytical or methodological techniques, videos, journal articles, computer programmes, lists of speakers, and case studies.

Session outline

Welcome participants to the session. Outline the overall coverage of the session, its objectives and why these are important in the EIA process.

The purpose of mitigation is to identify measures that safeguard the environment and the community affected by the proposal. Mitigation is both a creative and practical phase of the EIA process. It seeks to find the best ways and means of avoiding, minimising and remedying impacts.

Mitigation measures must be translated into action in the correct way and at the right time if they are to be successful. This process is referred to as impact management and takes place during project implementation. A written plan should be prepared for this purpose, and includes a schedule of agreed actions.

Introduce the link between the EIA process and the mitigation of adverse impacts. Broadly discuss what mitigation seeks to achieve.

Mitigation is a critical component of the EIA process. It aims to prevent adverse impacts from happening and to keep those that do occur within an acceptable level. Opportunities for impact mitigation will occur throughout the project cycle.


1

The objectives of mitigation are to:

- find better alternatives and ways of doing things;
- enhance the environmental and social benefits of a proposal;
- avoid, minimise or remedy adverse impacts; and
- ensure that residual adverse impacts are kept within acceptable levels.

Early links should be established between the EIA and project design teams to identify mitigation opportunities and incorporate them into consideration of alternatives and design options. In practice, mitigation is emphasised in the EIA process once the extent of the potential impact of a proposal is reasonably well understood. This typically takes place following impact identification and prediction, and recommended measures for mitigation will be an important part of the EIA report. Usually, these measures will be incorporated into the terms and conditions of project approval and implemented during the impact management stage of the EIA process.


2

The objectives of impact management are to:

- ensure that mitigation measures are implemented;
- establish systems and procedures for this purpose;
- monitor the effectiveness of mitigation measures; and

- take any necessary action when unforeseen impacts occur.

Discuss the proponent's responsibility for implementing mitigation and the potential long-term benefits to the proponent of appropriate mitigation.

The adverse impacts and consequences of a proposal can occur far beyond the site boundaries of a project. In the past, many of the real costs of development proposals were not accounted for in economic analyses of project feasibility, particularly in the operational and decommissioning phases of the project cycle. As a result, these costs were borne by the community affected or the public at large rather than by the proponent.


3

Stricter requirements are now being imposed on proponents to:

- mitigate impacts through good project design and environmental management;
- provide benefits to the community affected by the proposal;
- prepare plans for managing impacts so these are kept within acceptable levels; and
- make good any residual environmental damage.

The responsibility of proponents to 'internalise' the full environmental costs of development proposals is now widely accepted. In addition, many proponents have found that good design and impact management can result in significant savings. This outcome is similar to that found in industries applying the principles of cleaner production to improve their environmental performance. Like cleaner production, mitigation measures are more expensive in capital outlay but have been found to be cost effective over the long run.

The sustainability agenda is placing new demands on proponents with regard to mitigation and impact management. For example, increasing attention is being given to the principle of 'no net loss of natural and social capital'. Under the polluter pays principle, the application of this principle could require the proponent to make restitution for unavoidable residual damages. In this case, mitigation would include in-kind compensation measures, comprising equivalent, comparable or suitable offsets for all residual environmental impacts of a proposal.

Briefly discuss the main elements of mitigation and principles for their application. Consider how these might be used as part of EIA good practice locally.

In Figure 1 below, the elements of mitigation are organised into a hierarchy of actions: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- first, avoid adverse impacts as far as possible by use of preventative measures;
- second, minimise or reduce adverse impacts to 'as low as practicable' levels; and
- third, remedy or compensate for adverse residual impacts, which are unavoidable and cannot be reduced further.

Key principles for the application of mitigation consistent with the above framework include the following:

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- give preference to avoid and prevent measures;
- consider feasible alternatives to the proposal and identify the best practicable environmental option;
- identify customised measures to minimise each of the main impacts predicted;
- ensure they are appropriate, environmentally sound and cost-effective; and
- use compensation or remedial measures as a last resort.

EIA good practice in mitigation requires a relevant technical understanding of the issues and the measures that work in the circumstances.

Mitigation can be carried out by:

- *structural measures,* such as design or location changes, engineering modifications and landscape or site treatment; and
- *non-structural measures,* such as economic incentives, legal, institutional and policy instruments, provision of community services and training and capacity building.

Structural measures are well established for certain types of projects, such as dams, roads, and oil and gas exploration and development. In some cases, industry codes of good practice will be available. However, these need to be applied with regard to the nature and severity of environmental impacts; for example taking account of nearby protected areas, patterns of wildlife mitigation or constraints imposed by natural hazards. Other projects involving new technology may require non-standardised or even untried measures to mitigate the adverse impacts. These need to be given special attention during impact management.

Non-structural measures are used increasingly. They can be applied to reinforce or supplement structural measures or to address specific impacts. For example, many types of social, community and health impacts are addressed by non-structural measures and their use is becoming broader.

Elaborate the framework by which mitigation measures can be systematically identified and summarise the different actions that are involved.

A three-step process of mitigation can be applied to relate the hierarchy of elements in Figure 1 to the stages of the EIA process when they are typically applied. Generally, as project design becomes more detailed, the opportunities for impact avoidance narrow and the concern is to minimise and compensate for unavoidable impacts. However, these distinctions are not rigid and opportunities for creative mitigation should be sought at all stages of EIA and project planning.

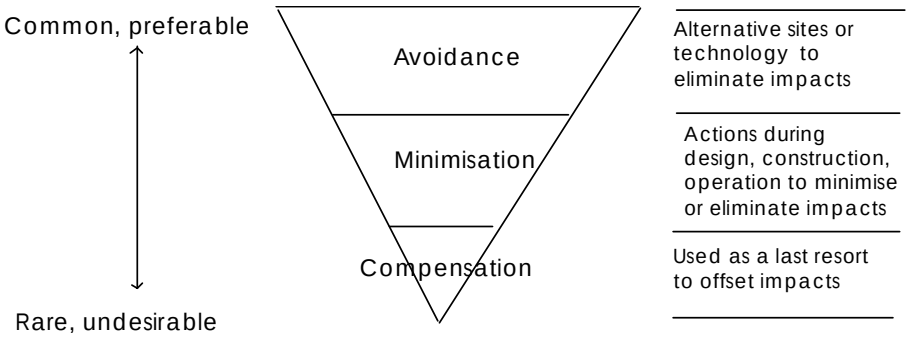

Figure 1: The elements of mitigation


6

Step One: Impact avoidance. This step is most effective when applied at an early stage of project planning. It can be achieved by:

- not undertaking certain projects or elements that could result in adverse impacts;
- avoiding areas that are environmentally sensitive; and
- putting in place preventative measures to stop adverse impacts from occurring, for example, release of water from a reservoir to maintain a fisheries regime.


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Step Two: Impact minimisation. This step is usually taken during impact identification and prediction to limit or reduce the degree, extent, magnitude, or duration of adverse impacts. It can be achieved by:

- scaling down or relocating the proposal;
- redesigning elements of the project; and
- taking supplementary measures to manage the impacts.


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Step Three: Impact compensation. This step is usually applied to remedy unavoidable residual adverse impacts. It can be achieved by:

- rehabilitation of the affected site or environment, for example, by habitat enhancement and restocking fish;

- restoration of the affected site or environment to its previous state or better, as typically required for mine sites, forestry roads and seismic lines; and
- replacement of the same resource values at another location, for example, by wetland engineering to provide an equivalent area to that lost to drainage or infill.

Describe the approaches that can be taken in EIA to mitigate impacts. Discuss these in detail, noting when and how they can be appropriate. Encourage the group to contribute to the discussion and provide local examples.

Depending on the timing of the project cycle and the nature of impacts, a number of approaches can be taken to achieve the objectives of mitigation. These include:

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- developing environmentally better alternatives to the proposal;
- making changes to project planning and design;
- carrying out impact monitoring and management; and
- compensating for impacts by
  - monetary payment
  - in kind measures
  - site remediation bonds
  - a resettlement plan.

Developing better alternatives

The development of alternatives to a proposed project is part of a comprehensive approach to mitigation. A broad range of alternatives can be generated at the earliest stages of project planning and design, when the process is still flexible (see Topic 5 -*Scoping*). At the later stages of project design, it is more realistic to identify feasible alternatives to the proposal. For example, impacts may be avoided or reduced by a reconsideration of the site or design alternatives and identifying the best practicable environmental option.

Making changes to project planning and design

Early consideration of environmental factors and impacts in project planning and design facilitates impact avoidance and minimisation. This requires coordination of the engineering, planning and EIA teams to:

- address the likely impacts throughout the life cycle of the project, including decommissioning; and
- identify the best practicable ways and means of mitigating them.

In practice, the elements of mitigation and the measures identified for a proposal will be tailored to the major impacts and the environment and community affected. A list of potential impacts for an extensive range of project types and suggested design measures to mitigate them can be found in *Volumes 2 and 3* of the *World Bank Environmental Assessment Sourcebook* and its various *Updates*. For example, almost all development proposals involve disturbance of the land surface. This is usually extensive for major linear projects (roads, pipelines), dams and reservoirs, and large-scale agriculture, forestry and housing schemes. Environmental impacts of particular concern can include drainage of wetlands, conversion of natural areas, or expansion into areas that are vulnerable to natural hazards.

The general considerations to be taken into account when mitigating the environmental impacts of housing schemes are described in Box 1. Specific measures that can be applied in planning and design of dams and reservoirs to avoid or reduce their impact are identified in Box 2. Looking ahead, the potential impacts of climate changes may have to be considered in mitigation planning and design, for example to address increased or reduced precipitation or inundation or saline influx into coastal areas as a result of a 1m rise in sea level.


7-1

Handout 7-1 provides further details of measures for mitigating the impacts of different types of projects. *Note that the references in the handout are to other tables within the Sourcebook*.

Box 1: Mitigation of large scale housing projects

Major adverse impacts	Mitigating measure
Displacement of existing land uses	Ensure that due consideration is given to the proper trade-offs between land values for housing and those of other uses, such as prime farmland, forests or natural habitats of value to society as a whole. Review existing planning and design standards to ensure that they are suited to local conditions and not unnecessarily wasteful of land. Make any necessary changes, for example by drafting new regulations
Destruction of environmentally critical areas	Ensure that regionally critical environmental sites, such as forested areas, major bodies and wetlands, habitats containing rare and endangered species, etc., are identified and not threatened by project location. Identify mitigation measures to avoid, reduce or compensate for environmental impacts and to enhance the environmental and community benefits of the proposal.

Source: adapted from the World Bank, 1991

Box 2: Case Example of mitigation of a dam project

The EIA for the Seco River Dam in Oaxaca Mexico identified a series of measures to avoid or minimise the impact of the proposed dam, including:

- replacing homes and lands of the people displaced
- operating and rehabilitating borrow pits in an appropriate manner
- establishing fish breeding programmes
- removing trees for wood from the site prior to flooding
- instituting environmental management regimes for the watershed, forestry, grazing etc.
- planting trees as barriers
- promoting agricultural practices that will reduce the need for water
- establishing technical advisory, financing and social service programmes

Sanchez-Silva and Cruz-Ulloa, (1994)

Carrying out impact monitoring and management

Mitigation measures are implemented as part of impact management. This process is accompanied by monitoring to check that impacts are 'as predicted'. When unforeseen impacts or problems occur, they can require corrective action to keep them within acceptable levels, thereby changing the mitigation measures recommended in an EIA or set out in an environmental management report (described later in this topic). Further information on monitoring and implementation can be found in Topic 11 – *Implementation and follow up.*

In some cases, it may be necessary to establish or strengthen impact management systems to facilitate the implementation of mitigation measures during project construction and operation. These supporting actions should be identified as part of the environmental management plan. They can include the establishment of an environmental management system (EMS) based upon ISO 14000 guidelines for strengthening particular arrangements for impact management. Any other supporting actions to implement these measures, such as training and capacity building, should also be specified.

The management of social impacts associated with the influx of a temporary workforce and additional population will require specific mitigation measures. These include the provision of:

- improved transport, water and sewage infrastructure;
- expanded social and health care services, including measures to target specific impacts;
- better support and counseling services to cope with socio-economic changes; and
- additional recreational areas and facilities, including full replacement of any areas lost to development.

Compensating for impacts

Monetary compensation

Traditionally, compensation has meant payment for loss of land or amenity resulting from a proposal. This approach can be appropriate in certain circumstances; for example, when private property must be expropriated to make way for a road or other public infrastructure project, or land owners are paid rent or lump sum compensation for access to or use of their property to drill for sub-surface resources. In addition, compensation packages, containing a range of offsets, may be negotiated with affected communities. These may include a direct monetary payment or a capital investment by the proponent.

Site remediation bonds

Recently, attention has also focused on problems of contaminated land and the requirements for site remediation. Where this is a potential issue,

mitigation measures should be directed at both prevention of contamination and provision for clean up during decommissioning. Because of the time period, project ownership may change or the proponent may be unable to complete the mitigation plan for other reasons. As insurance, a bond system can be used to ensure that sufficient funds will be available for the required mitigation.

Resettlement plans

Special considerations apply to mitigation of proposals that displace or disrupt people. Certain types of projects, such as reservoirs and irrigation schemes and public works, are known to cause involuntary resettlement. This is a contentious issue because it involves far more than re-housing people; in addition, income sources and access to common property resources are likely to be lost.

Almost certainly, a resettlement plan will be required to ensure that no one is worse off than before, which may not be possible for indigenous people whose culture and lifestyle is tied to a locality. This plan must include the means for those displaced to reconstruct their economies and communities and should include an EIA of the receiving areas. Particular attention should be given to indigenous, minority and vulnerable groups who are most at risk from resettlement.

In kind compensation

When significant or net residual loss or damage to the environment is likely, in kind compensation is appropriate. As noted earlier, environmental rehabilitation, restoration or replacement have become standard practices for many proponents. Now, increasing emphasis is given to a broader range of compensation measures to offset impacts and assure the sustainability of development proposals. These include impact compensation 'trading', such as offsetting CO_2 emissions by planting forests to sequester carbon. Further discussion of these issues can be found in Topic 15 – *Future directions*.

Discuss the positive contribution that EIA can make when an environmental management plan (EMP) is prepared to monitor and manage the impacts over the life of the project and to ensure that mitigation measures are implemented at the appropriate time during construction.

An EIA report contains predictions about the environmental impacts of proposals and recommendations for their mitigation and management. The report is essentially a discretionary planning document. Usually, a separate project approval sets the terms and conditions with which the proponent must comply.

An environmental management plan (EMP), also referred to as an impact management plan, is usually prepared as part of EIA reporting. It translates recommended mitigation and monitoring measures into specific actions that will be carried out by the proponent. Depending upon particular requirements, the plan may be included in, or appended to, the EIA report or may be a separate document. The EMP will need to be adjusted to the terms and conditions specified in any project approval. It will then form the basis for impact management during project construction and operation.


10

The main components of an EMP are described in Box 3, which reflects practice at the World Bank. Although there is no standard format, the EMP should contain the following:

- summary of the potential impacts of the proposal;
- description of the recommended mitigation measures;
- statement of their compliance with relevant standards;
- allocation of resources and responsibilities for plan implementation;
- schedule of the actions to be taken;
- programme for surveillance, monitoring and auditing; and
- contingency plan when impacts are greater than expected.

Box 3: Components of an environmental management plan (EMP)


7-2

The following aspects should typically be addressed within an EMP:

Summary of impacts: The predicted adverse environmental and social impacts for which mitigation is required should be identified and briefly summarised. Cross-referencing to the EA report or other documentation is recommended.

Description of mitigation measures: Each mitigation measure should be briefly described with reference to the impact to which it relates and the conditions under which it is required (for example, continuously or in the event of contingencies). These should be accompanied by, or referenced to, project design and operating procedures which elaborate on the technical aspects of implementing the various measures.

Description of monitoring programme: The monitoring program should clearly indicate the linkages between impacts identified in the EIA report, measurement indicators, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions.

Institutional arrangements: Responsibilities for mitigation and monitoring should be clearly defined, including arrangements for co-ordination between the various actors responsible for mitigation.

Implementation schedule and reporting procedures: The timing, frequency and duration of mitigation measure should be specified in an implementation schedule, showing links with overall project implementation. Procedures to provide

information on the progress and results of mitigation and monitoring measures should also be clearly specified.

Cost estimates and sources of funds: These should be specified for both the initial investment and recurring expenses for implementing all measures contained in the EMP, integrated into the total project costs, and factored into loan negotiations.

Source: World Bank, 1999

The EMP should contain commitments that are binding on the proponent. It can be translated into project documentation and provide the basis for a legal contract that sets out the responsibilities of the proponent. In turn, the proponent can use the EMP to establish environmental performance standards and requirements for those carrying out the works or providing supplies. An EMP can also be used to prepare an environmental management system for the operational phase of the project.

Include a training activity to reinforce the topic (if desired).

Conclude by summarising the presentation, emphasising the key aspects of the topic that apply locally.

Reference list

The following references have been quoted directly, adapted or used as a primary source for major parts of this topic.

OECD – Organisation for Economic Cooperation and Development (1992) *Economic Instruments for Environmental Management in Developing Countries.* OECD, Paris.

Sadar M and Associates (1995) *Environmental Impact Assessment*. Carleton University, Ottawa, Canada.

Sanchez-Silva R and Cruz-Ulloa S (1994) Environmental Impact of an Agricultural Project in La Roca, Oxaca, Mexico. *Impact Assessment*. Vol 12 (1).

World Bank (1991) *Environmental Assessment Sourcebook* (three volumes). Technical Papers Nos. 139, 140 and 154, World Bank, Washington D.C.

World Bank (1995) *Environmental Assessment Challenges and Good Practice.* Environment Department Papers No. 18, World Bank, Washington D.C.

World Bank (1999) Environmental Management Plans. *Environmental Assessment Sourcebook Update,* Number 25, Environment Department, World Bank, Washington D. C.

Further reading

Scott Wilson Ltd. (1996) *Environmental Impact Assessment: Issues, Trends and Practice.* Environment and Economics Unit, UNEP, Nairobi.

Canter L (1996) Environmental Impact Assessment. McGraw Hill, New York.

Training activities

Training activities will be more instructive if they are framed around a local proposal. Consider inviting prospective course participants to make a presentation if they have expertise in this area of EIA.

Discussion themes

7-1 For a particular project type, get the group to identify the range of typical impacts that could be expected and the different ways in which these impacts could be mitigated.

7-2 Identify the types of situations when 'in-kind' compensation should be required of proponents. What can be done if an 'in-kind' solution appears to be impracticable?

7-3 As a group, develop a checklist method for producing an impact management plan from an EIA report and any associated approval conditions.

7-4 Discuss approaches that can be taken to encourage construction contractors to comply with the environmental policy of the proponent.

7-5 Discuss the difference in approach to the mitigation and management of impacts. What could be done in the event that an impact is greater than forecast and exceeds an environmental standard (e.g. for air or water discharge)?

Speaker themes

7-1 Invite a speaker who has experience in implementing the recommendations of EIA reports to outline the approaches that have, and have not, been successful.

7-2 Invite a speaker who has prepared an environmental management plan (or an equivalent document) to outline the process that was followed and to comment on how successful it has been in practice.

7-3 Invite, as a speaker, a proponent/project manager for an EIA to describe the process to establish measures to mitigate the adverse environmental impacts, giving particular attention to their early identification by the EIA and project design teams.

Group Activity 7–1: Mitigation and impact management

Title: **Producing impact management plans**

Aim: Practical grasp of identifying project recommendations, approval conditions and items that require monitoring and in turning them into specific, actionable tasks.

Group size: Four or five people

Duration: Half-day

Resources required:

- ❑ EIA reports and case study materials for each group.

Description of activity:

- ❑ As a group develop the main elements of an impact management plan for the case study project (see Handout 7–2: *Preparing an impact management plan*).
- ❑ Each group then reports back to the whole group.
- ❑ The group as a whole identifies commonalities and differences in the different plans.

Group Activity 7-2: Mitigation and impact management

Title: **Impact mitigation**

Aim: Understanding of quick identification of potential major impacts and possible mitigation measures.

Group size: Three or four people

Duration: One hour

Resources required:

- A set of approximately five project outlines and descriptions of environmental settings.

Description of activity:

- Spending approximately ten minutes on each project, identify the potential major impacts associated with each proposal and outline mitigation measures that might be appropriate in each case.


1

The purpose of mitigation is to:

- find better ways of doing things
- enhance environmental and social benefits
- avoid, minimise or remedy adverse impacts
- ensure that residual impacts are within acceptable levels.


2

The purpose of impact management is to:

- ensure mitigation measures are implemented
- establish systems and procedures for this purpose
- monitor the effectiveness of mitigation measures
- take action when unforeseen impacts occur.


3

Proponents have a responsibility to:

- avoid, minimise and remedy adverse impacts
- internalise the environmental and social costs of the proposal
- prepare plans for managing impacts
- repair or make restitution for environmental damages.


4

A framework for impact mitigation


5

Principles of mitigation

- give preference to avoid and prevent measures
- consider feasible alternatives to the proposal
- identify customised measures to minimise each major impact
- ensure they are appropriate and cost-effective
- use compensation as a last resort.


6

Impact avoidance can be achieved by:

- not undertaking certain projects or elements
- avoiding environmentally sensitive areas
- use of measures to prevent impacts from occurring
  - – site remediation bonds
  - – resettlement plans
  - – in kind measures and offsets


7

Impact minimisation can be achieved by:

- scaling down or relocating the proposal
- redesigning elements of the project
- measures to manage the impacts.


8

Impact compensation can be achieved by:

- rehabilitation of resource or environmental components
- restoration of the site to its previous state
- replacement of the environmental values lost at another location.


9

Mitigation options

- develop alternatives that are better environmentally
- make changes in planning and design
- carry out impact monitoring and management
- compensate for residual impacts
  - monetary payment
  - site remediation bonds
  - resettlement plans
  - in kind measures and offsets


10

Environmental management plans should contain a:

- summary of impacts
- recommended mitigation measures
- statement of compliance with standards
- allocation of resources and responsibilities
- schedule of required actions
- surveillance, monitoring and auditing programmes
- contingency measures for greater than expected impacts

Mitigation for large scale housing projects

Potential negative impacts		Mitigating measure
DIRECT IMPACTS		
1.	Displacement of existing land uses	Ensure that due consideration is given to the proper trade-offs between land values for housing and those of other uses, such as prime farmland, forests or other land uses or natural habitats of value to society as a whole. Investigate existing planning and design standards to ensure that they are suited to local conditions and not unnecessarily wasteful of land. Assist in drafting new regulations that are more appropriate.
2.	Destruction of environmentally critical areas	Ensure that regionally critical environmental sites, such as major forested areas, major water bodies and wetlands, habitats containing rare and endangered species, etc., are identified and not threatened by project location.
3.	Danger to residents from hazardous natural conditions	Ensure that project site is not located in the following areas: • major floodplain • coastal zone inundation areas • areas of unstable soil or subsurface conditions • areas of highly saline soils • areas subject to landslides • seismically or volcanically active areas • excessively steep or wet areas • areas where significant risk from disease vectors exist or any other areas of significant natural hazard. Design accordingly if site cannot be moved.
4.	Danger to residents from hazardous man-made conditions	Identify areas that have significant man-made hazards such as filled land, areas subject to subsidence from mining activity, groundwater, oil or other extractive process. Identify areas where solid or liquid or toxic wastes may be, or have been, dumped. Investigate site conditions with proper geo-technical or chemical testing procedures. Ensure that adequate funding and technical expertise are available to deal with the special conditions. Investigate alternate sites.
5.	Hazard to residents from air, water or noise pollution from other adjacent or nearby land uses	Ensure that the site is located away from such pollution sources. Do not locate down-wind of significant point sources of air pollution such as smoke stacks. Identify noise sheds around airports, major roads, etc. Provide buffers of other compatible uses of adequate width between residential areas and sources of pollution. Take measures to abate pollution at source, if feasible; such as noise barriers along expressways are an example. Investigate alternate sites.
6.	Hazard to residents from air pollution due to site location being in an area subject to frequent temperature inversions	Seek alternate site locations if pollution is from existing sources that are difficult to abate. Otherwise design project with low densities and non-polluting technologies for heating, cooking, etc.
7.	Dislocation of existing resident populations	Ensure that any involuntary resettlement is done in accordance with proper standards or consider alternate sites.
8.	Destruction of historic or cultural resources	Consider alternate sites or make provisionto set aside and zone historic and culturally significant areas.
9.	Overloading of existing infrastructure and services	Coordinate with other planning goals and objectives for region. Upgrade existing infrastructure and services, if feasible. Consider alternate sites.
10.	Excessive depletion of resources such as lumber or fuel or overtaxing of traditional industries, such as brickmaking	Review capacity of local resources and industries to provide for large-scale construction and upgrade if feasible. Select materials and design criteria according to local conditions and availability of resources. Design for maximum efficiency in material and energy use. Encourage the study of indigenous customs and techniques for building and incorporate in project design.
LOCAL AND SITE SCALE IMPACTS		

Mitigation for large scale housing projects (continued)

11.	Damage to sites and their immediate surroundings resulting from the disruption of the natural environment, in particular the soil, vegetation and drainage network (see below for more detailed comments).	Identify the basic natural systems of a site and its immediate surroundings and protect with set-asides for open space, easements and buffer areas etc. Adapt layouts to fit natural patterns rather than imposing rigid geometries.
12.	Degradation of habitats caused by fragmentation	Maintain and/or design open space networks to follow natural site features, such as stream corridors, and connect the site and local and regional open space systems.
13.	More extreme flood/drought cycles, increased erosion and siltation and degradation of stream biota and riparian vegetation etc caused by increased runoff from developed sites	Preserve existing vegetation, particularly intact natural habitats. Institute a stormwater management plan including strategies such as: • minimising impervious area • increasing infiltration to soil by use of recharge areas • use of natural vegetated swales instead of pipes or • installing detention or retention facilities with graduated outlet control structures. Use 'soft engineering' techniques for soil and bank stabilization such as vegetative stabilization (soil bio-engineering), in preference to built structures.
14.	Depletion and/or pollution of local groundwater resources	Ensure that projected use of groundwater is within the capacity of natural system to replenish itself. Avoid 'mining' groundwater particularly in drier climates. Use indigenous vegetation that requires less water, drip irrigation or shaded plantings. Ensure that soils are suitable for septic tank or other on-site treatment. Design stormwater management systems as suggested above, in particular use vegetation to retain recharge and purify stormwater.
15.	Degradation of soil cover from erosion, removal, or loss of soil structure due to compaction	Have both temporary (during construction) and permanent erosion control plans. Temporary control plans should include: • silt fencing • temporary silt trap basins • short term seeding or mulching of exposed soil areas (particularly on slopes) • limitations on access for heavy machinery and the storage of materials to avoid soil compaction. Permanent erosion control plans should focus on the establishment of stable native vegetation communities. Ensure that topsoil in construction areas is stripped and stored for future use and not illegally removed from site.
16.	Loss or degradation of vegetation from unnecessary removal or mechanical damage	Identify important stands of vegetation, large contiguous stands of forest or other habitat, vegetation on steep slopes, and stream corridors or swales. Incorporate these areas into design layout or open space system. Protect such areas during construction by temporary fencing and limitations on access for heavy machinery and materials storage.
17.	Degradation of habitat from inappropriate management or introduction of invasive exotic species	Protect natural habitat from destructive management or maintenance practices, such as the removal of understorey vegetation from woodlands, or excessive clearance of vegetation from stream banks. Do not use invasive exotic species for landscaping or reforestation.

From: Environmental Assessment Sourcebook (World Bank, 1991)

Mitigation for roads and highways

Potential negative impacts		Mitigating measure
DIRECT IMPACTS		
1.	Increased sediment in streams affected by erosion at construction sites and fresh road cuts, fills and waste dumps.	Protect susceptible surfaces with mulch or fabric, and plant non-erodible surfaces as soon as possible.
2.	Soil and water contamination by oil, grease, fuel and paint in equipment yards and asphalt plants.	Collect and recycle lubricants. Avoid accidental spills through good practice.
3.	Air pollution from asphalt plants.	Install and operate air pollution control equipment.
4.	Local dust and noise.	Periodically water down or lightly oil temporary roads. Install and maintain mufflers on equipment.
5.	Air and noise pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas.	Include physical barriers to noise in plans. Require adherence to engine maintenance schedules and standards (or use alternative fuels) to reduce air pollution. Enhance public transportation and traffic management capability.
6.	Landscape disfiguration by embankments and deep cuts, fills and quarries.	Use an architectural design to 'blend' with the landscape. Replant disfigured surfaces.
7.	Landslides, slumps, slips and other mass movements in road cuts.	Provide drainage works as needed to reduce risk, according to prior surveys. Align route to avoid inherently unstable areas. Stabilize road cuts with structures (concrete walls, dry wall masonry, gabions, etc).
8.	Erosion of lands below the road bed receiving concentrated outflow from covered or open drains.	Increase number of drain outlets. Place drain outlets so as to avoid cascade effect, Line receiving surface with stones, concrete.
9.	Roadside litter.	Provide for disposal facilities. Encourage anti-littering laws and regulations.
10.	Hazardous driving conditions where construction interferes with pre-existing roads.	Provide in design for proper markers on roads, including lights.
11.	Alteration of overland drainage and subsoil drainage (where road cuts intercept perched water tables, springs etc).	Installation of adequate drainage works.
12.	Destruction of vegetation and wildlife in the right-of-way occupied by the highway.	Realignment where possible to detour exceptional areas, identified by prior surveys.
13.	Destruction or damage of terrestrial wildlife habitats, biological resources or ecosystems that should be preserved.	Plan national transportation route alignment to avoid location of fragile, unique, etc areas.
14.	Alteration of hydrological regimes of wetlands by causeways, with harmful effects on these ecosystems.	Realignment to avoid wetlands. Installation of culverts, bridges, etc as needed and according to criteria from prior hydrological surveys.
15.	Interruption of migratory routes for wildlife and livestock. Increased collisions with animals.	Realign to avoid important migratory routes. Provide undergrade crossings.
16.	Poor sanitation and solid waste disposal in construction camps and work sites.	Provide adequately located and maintained latrines.
17.	Possible transmission of communicable diseases from workers to local populations and vice-versa.	Periodic health examinations of workers with treatment when needed.
18.	Creation of temporary breeding habitats for mosquito vectors of disease, e.g. sunny, stagnant pools of water.	Assess vector ecology in work areas and take steps where possible to avoid creating habitats.
19.	Creation of transmission corridor for diseases, pests, weeds and other undesirable organisms.	Set up plant and animal sanitation service and related checkpoints.
20.	Poaching by construction workers.	Prohibit poaching under terms of employment.

Mitigation for roads and highways (continued)

21.	Dislocation and compulsory resettlement of people living on the right-of-way. (Near cities and in rich farming regions, many people can be affected.)	Locally unprecedented mechanisms and procedures may be required to arrive at equitable and adequate compensation, and a companion effort to develop the capacity may be required.
22.	Obstruction of routes from homes to farms, etc., increasing travel time.	Provide appropriately designed and located crossings.
23.	Impairment of non-motored transportation in the highway corridor due to reduced or impeded rights-of-way.	Design and implement safety measures and an emergency plan to contain damages from accidental spills. Designate special routes for hazardous materials transport.
INDIRECT		
25.	Induced development: roadside commercial, industrial, residential and 'urban sprawl'.	Involve land-use planning agencies at all levels in project design and EA and plan for controlled development.
26.	Increased motorized transportation (with possible increased dependency on imported fuels).	Include project components to encourage use of no-motorized transportation.
27.	Impairment of non-motorized transportation economy due to changes in land use and/or increased availability of motorized alternatives.	Include project components to stimulate local production and use of non-motorized modes of transportation.

From: Environmental Assessment Sourcebook (World Bank, 1991)

Note: Further information and examples of mitigating measures for other types of projects can be located in the Sourcebook.

Preparing an impact management plan

1. Note or establish an environmental policy for the proposal

- An environmental policy for a proposal should contain a concise statement of the commitment to certain standards of environmental performance and behaviour. It could for instance state that 'maximum use will be made of locally grown plantation timbers' or that 'all contractors will be required to produce their own environmental management plans and quality reports as the initial part of their contracts.'
- Think of ways to raise stakeholder awareness and commitment to the policy (employees, contractors, suppliers, client, community) and to ensure that they understand what is trying to be achieved and why

2. Designate a person to take overall responsibility for the impact management plan

A person or a group should be specifically allocated responsibility for the development, implementation and performance review of the impact management plan.

3. Identify tasks

- Examine the EIA and the conditions for approval to identify all commitments and obligations made regarding the environment.
- Identify any other environmental /impact management requirements arising from regulations, policies, guidelines, etc.
- Identify requirements for staff training.
- Identify a range of implementation tools that can be used to ensure that impact management is undertaken e.g. setting objective conditions for contracts, tenders, permits and licenses, establishing performance bonds to ensure environmental outcomes are achieved, etc.

4. Establish a plan and allocate responsibility

- Draw up a time based schedule of the identified tasks and allocate responsibility for each of them (see sample outline).
- Develop contingency plans that highlights actions to be taken and assigns obligations in the event of the detection of unacceptable adverse impacts.
- Check that those undertaking the detailed design of the project incorporate all commitments and obligations.
- Budget for the plan.

Impact Management Plan-sample task schedule

No.	Task Description	Responsible person/unit	Start Date	Finish Date	2002				2003				2004			

5. Develop a management system for monitoring, reporting and response

- Identify monitoring requirements and responsibilities.
- Establish a system of reporting at intervals that are appropriate to the various tasks (daily, weekly, monthly).
- Establish a system for data storage, retrieval and access.
- Establish a system for investigating and responding to complaints and enquires from outside parties.

6. Implement management system

7. Review performance

- Establish a system of meetings to review issues arising out of the reporting and to focus on preventative and remedial measures.
- Conduct independent audits (compliance and surveillance) regularly.
- Update/review the impact management plan regularly.