Environmental and Social Management Guidelines in the Road Sector

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Malawi
Africa

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Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgement</td>
<td>v</td>
</tr>
<tr>
<td><strong>Environmental Policy Statement</strong></td>
<td>vi</td>
</tr>
<tr>
<td>Preface</td>
<td>viii</td>
</tr>
<tr>
<td>Acronyms</td>
<td>ix</td>
</tr>
<tr>
<td><strong>1.0 Introduction</strong></td>
<td>1</td>
</tr>
<tr>
<td>1.1 Background</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Users of the Guidelines</td>
<td>2</td>
</tr>
<tr>
<td>1.3 Legislative and Environmental Policy Frame</td>
<td>2</td>
</tr>
<tr>
<td>1.4 The Project Cycle</td>
<td>2</td>
</tr>
<tr>
<td><strong>2.0 Environmental Impact Assessment</strong></td>
<td>4</td>
</tr>
<tr>
<td>2.1 The EIA Process</td>
<td>4</td>
</tr>
<tr>
<td>2.1.1 Screening</td>
<td>4</td>
</tr>
<tr>
<td>2.1.2 Scoping</td>
<td>5</td>
</tr>
<tr>
<td>2.1.3 The EIA Study</td>
<td>5</td>
</tr>
<tr>
<td>2.1.4 The EIA Report</td>
<td>6</td>
</tr>
<tr>
<td><strong>3.0 Environmental Impacts</strong></td>
<td>7</td>
</tr>
<tr>
<td>3.1 Air Related Impacts</td>
<td>7</td>
</tr>
<tr>
<td>3.1.1 Dust</td>
<td>7</td>
</tr>
<tr>
<td>3.1.2 Exhaust fumes</td>
<td>8</td>
</tr>
<tr>
<td>3.2 Soil Related Impacts</td>
<td>8</td>
</tr>
<tr>
<td>3.2.1 Mitre drains/Culverts</td>
<td>9</td>
</tr>
<tr>
<td>3.2.2 Shoulders</td>
<td>9</td>
</tr>
<tr>
<td>3.3 Borrow Pits</td>
<td>9</td>
</tr>
<tr>
<td>3.4 Solid Waste</td>
<td>10</td>
</tr>
<tr>
<td>3.4.1 Rubble Disposal</td>
<td>10</td>
</tr>
<tr>
<td>3.4.2 Bitumen Spillage</td>
<td>10</td>
</tr>
<tr>
<td>3.4.3 Solvent Disposal</td>
<td>10</td>
</tr>
<tr>
<td>3.5 Noise Disturbances</td>
<td>10</td>
</tr>
<tr>
<td>3.5.1 Blasting at Quarries</td>
<td>11</td>
</tr>
<tr>
<td>3.6 Ecosystems</td>
<td>11</td>
</tr>
<tr>
<td>3.7 Sanitation</td>
<td>12</td>
</tr>
<tr>
<td>3.7.1 Latrines</td>
<td>12</td>
</tr>
<tr>
<td>3.8 Water</td>
<td>12</td>
</tr>
<tr>
<td>3.9 Landscape</td>
<td>13</td>
</tr>
<tr>
<td>3.10 Community activities</td>
<td>14</td>
</tr>
<tr>
<td>3.11 Displacement and resettlement</td>
<td>15</td>
</tr>
<tr>
<td>3.12 Cultural Heritage</td>
<td>17</td>
</tr>
<tr>
<td>3.13 Human health and safety</td>
<td>18</td>
</tr>
</tbody>
</table>
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The Road Agency would also like to thank the World Bank and Malawi Government for directing the process and research that was involved to ensure that the endeavour is a success.
Environmental Policy Statement

NRA VISION

By the year 2020, the Malawi public road network be developed and maintained up to a standard where all motorized and non-motorized traffic reach every society in the country in an adequate, safe, reliable, efficient, economic and in an environmental friendly manner at all times of the year.

NRA's Mission Statement

Develop and maintain public road network infrastructure investment in a cost effective manner with a view to providing accessible, reliable, efficient, safe, sustainable and most economic transport system.

To achieve the Vision and fulfil the Mission Statement NRA endeavours to:

• Comply with the relevant health, safety legislation in accordance with Section 13(d) of the Malawi Constitution and adherence to the environmental best practices for the roads sector;

• Prevent adverse environmental effects of road construction and ensuring that the infrastructure itself is environmental friendly through;
  
  o The inclusion of EIA in the planning of the construction of roads and energy conservation;

  o Promotion of environmental protection and resource conservation;

  o Ensuring that roads do not impede drainage and cause water stagnation resulting in water pools that may become breeding places for disease vectors and pathogens;

  o Ensuring that drainage outlets do not become the primary sources of erosion;

  o Promoting the use of more energy-efficient and less polluting modes of transport
• Enforce environmental standards and specifications in line with MBS - ISO 14,000 series;

• Carry out on-site supervision on sites with consultants and contractors to ensure environmental due diligence; and that agreed environmental; health and safety standards designed to reduce associated risks during construction and operation, are being followed;

• Report on the compliance with environmental commitments, the status of the mitigation measures and the results of the monitoring programmes to consultants, contractors, stakeholder and members of the public; and get feedback on the requisite environmental performance information;

• Develop specified performance indicators to enhance the review of progress in implementing mitigation measures; and where necessary recommending remedial measures;

• Conduct training in EIA and in safe and practical and efficient work procedures to minimize the negative impacts and enhance positive impacts by adopting the precautionary principle; the polluter pays principle and best available technology that entails the least environmental cost (BATNEEC)

• Prepare and implement environmental risk management and road safety plans;

• Prepare environmental guidelines and best practices for road construction, maintenance and environmental management for use in the sector.

• Compliment activities and endeavours of partners in the Transport Sector like Rail, Aviation and Marine Transport Systems.
Preface

Malawi is experiencing numerous problems of environmental degradation. This is due to rapid population growth and man's desire for improved living standards. Major environmental problems being experienced in Malawi include soil erosion, deforestation, water resources degradation and depletion, threat to fish resources, threat to biodiversity, human habitat degradation, air pollution and climate change. The Malawi Road Sector activities with regard to road construction and maintenance contribute to these either directly or indirectly in its efforts to contribute to national development.

The Malawi National Assembly enacted the National Roads Authority Bill in 1997. The Object of the NRA Act is to ‘make provision for the establishment of the National Roads Authority for the maintenance, rehabilitation and development of public roads, and for purposes connected there with and incidental thereto’. Further to that, the National Road Policy of Malawi section 7.3: Environmental Issues underscores the prevention of adverse environmental effects of road construction and ensuring that the infrastructure is environmentally friendly using the following strategies:

- Including in the planning for the construction of the roads environmental impact assessment (EIA) and energy conservation;
- Promoting environmental protection and resource evaluation;
- Ensuring that roads do not impede on drainage and cause accumulation of water pools that become breeding grounds for mosquitoes and other disease causing vectors;
- Ensuring that drainage outlets do not become the primary sources of soil erosion; and
- Promoting the use of more energy efficient and less polluting modes of transport.

The National Roads Authority Act; Part ix: Miscellaneous Section 30 empowers the Minister for Transport and Public Works to make regulations and guidelines for better carrying into effect of the act. It is to full this and achieve the NRA Mission Statement and Vision that these guidelines have been developed for Contractors, Consultants, Engineers and other stakeholders to facilitate the implementation of activities in the road sector.

We hope that users of these Guidelines will utilize them to the fullest for the benefit of the Malawi Nation.

M.Y. Kachiwala
Ag. CHIEF EXECUTIVE OFFICER
### Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BoQ</td>
<td>Bill of Quantities</td>
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<tr>
<td>CSW</td>
<td>Commercial Sex Workers</td>
</tr>
<tr>
<td>DEA</td>
<td>Director of Environmental Affairs</td>
</tr>
<tr>
<td>EAD</td>
<td>Environmental Affairs Department</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMA</td>
<td>Environmental Management Act</td>
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<td>EMP</td>
<td>Environmental Management Plan</td>
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<td>NCE</td>
<td>National Council for the Environment</td>
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<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
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<tr>
<td>NRA</td>
<td>National Roads Authority</td>
</tr>
<tr>
<td>RA</td>
<td>Road Agency</td>
</tr>
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<td>SMEC</td>
<td>Snowy Mountains Exploration Company</td>
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<td>TCE</td>
<td>Technical Committee on the Environment</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference</td>
</tr>
</tbody>
</table>
Environmental and Social Management Guidelines in the Road Sector

1.0 Introduction

Malawi is experiencing numerous problems of environmental degradation. This is due to rapid population growth and man’s desire for improved living standards. Major environmental problems being experienced in Malawi include soil erosion, deforestation, water resources degradation and depletion, threat to fish resources, threat to biodiversity, human habitat degradation, air pollution and climate change. The Malawi Road Sector activities with regard to road construction and maintenance contribute to these either directly or indirectly in its efforts to contribute to national development.

The aim of this document is therefore to provide guidelines for integrating environmental issues in the overall road project cycle (planning, design, and implementation). As a guideline, the document is neither legal nor a book of recipes but rather provides options which road agencies, consulting engineers and contractors could consider in relation to their specific conditions.

1.1 Background

In 2001, NRA contracted the Millennium Consulting Group/ ESG International Inc to develop a work plan for the improvement of environmental management in the Road Sector. The overall objective of the action plan was to ensure that local, regulatory framework, principles and procedures are established for environmental management.

The consultants reviewed Roads sector Environmental Review Guidelines developed by SMEC to establish the adequacy for wide spread adoption in the country, and if not, propose how best they can be improved so that NRA and its private sector partners can have simple, effective and consistent guidelines for road sector environmental management.

This work follows a thorough review of SMEC and Millennium consulting Group/ ESG International Inc reports. This work is also based on the key environmental assessment documents and guidelines including:

- Environmental Impact Assessment Guidelines for Malawi
- World Bank Environment Assessment Sourcebook (Volume 1, 2, 3)
- National Transport Policy of Malawi

EAD
1.2 Users of the Guidelines

This guide is intended for:
• Those concerned with preparation and supervision of contracts such as relevant road agencies and private sector Consulting Engineers
• Those directly involved in executing and rehabilitation works such as private sector Contractors, and
• Those concerned with monitoring and evaluation of environmental mitigation plans such as the Department of Environmental Affairs and the relevant road agencies.
• Academic Institutions, Environmental Conservation Advocates,
• Donors, Non governmental Institutions and Community Based Organizations.

1.3 Legislative and Environmental Policy Framework in Malawi

To develop an effective Action Plan for Environmental Management in the Road Sector in Malawi, it is important to understand the relevant legislative and policy framework. The Environment Management Act (EMA) came into force in 1996 and provides the legal foundation for Environmental Impact Assessment in Malawi, Sections 24-26 of the EMA deal with EIA. The Act empowers the Environmental Affairs Department (EAD) to be the administrators of EIA in Malawi. The Technical Committee on the Environment (TCE), also set up under the Act, provides advice to the EAD on EIA matters, amongst other responsibilities. The EIA process in Malawi is described in the Malawi EIA Guidelines, published in December 1997.

The “Prescribed List for which EIA is Mandatory”, gazetted under section 24 of the Act, sets out which activities must have an EIA before they can be implemented. If a developer is proposing a “prescribed project”, EIA applies, and the developer needs to submit a project brief. The content requirements for a project brief are set out in the EIA Guidelines. The brief needs to have sufficient detail for the EAD to decide if a full EIA is warranted. If a full EIA is warranted, ToRs are proposed by the developer and finalized by the EAD on the advice of the TCE. Final decisions on EIAs are the responsibility of the Director of Environmental Affairs. The Director may approve an EIA (with or without terms and conditions), reject the EIA or instruct the developer to revise either the project or the EIA document.

Following the submission of a project brief, the EAD may determine that the project does not require an EIA, but might still have some potential for environmental effects. In this case, the EAD can prescribe environmental recommendations relating to the project (Refer to The Malawi EIA process Annex 1: Environmental Checklists Annex 2 and Prescribed Projects that Affect Road Development: Annex 3).

1.4 The Project Cycle

The implementation of road projects by the Roads Agency follows the standard project cycle and these guidelines have been prepared in relation to the cycle. For any system of environmental management to be built into roads sector activities in Malawi, one needs to have a good understanding of the existing project cycle that exists between NRA and its private sector partners. Once this project cycle is understood, specific environmental activities which would take place at each of the project cycle stages can be identified, as well as who the appropriate parties are to undertake those activities.
Key stages of RA’s Project Cycle for roads sector works, from start to finish, are summarized in Table 1, below:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Milestone Activities</th>
<th>Primary Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Identification</td>
<td>• Preparation of priority list</td>
<td>RA, Donors</td>
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<tr>
<td></td>
<td>• Selection of priority roads</td>
<td></td>
</tr>
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<td>Project Preparation</td>
<td>• Road design</td>
<td>RA, Contractors</td>
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<td></td>
<td>• Preparation of tender documents</td>
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<td></td>
<td>• Preparation of Bids</td>
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<td>Project Appraisal</td>
<td>• Bid Evaluation</td>
<td>RA, donor</td>
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<tr>
<td></td>
<td>• Award of Contract</td>
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</tr>
<tr>
<td>Project Implementation</td>
<td>• Rehabilitation/construction/maintenance</td>
<td>Contractor, Consultant</td>
</tr>
<tr>
<td>Project Completion/Evaluation</td>
<td>• Certificate of completion</td>
<td>RA</td>
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<td></td>
<td>• Final payment on contract</td>
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</tr>
</tbody>
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2.0 Environmental Impact Assessment

EIA is both a process and a tool for planning and decision-making. It aims to:

- Integrate environmental considerations into development planning thereby promoting sustainable development;
- Ensure that environmental and socio-economic benefits and costs of economic development projects are properly accounted for;
- Ensure that unwarranted negative impacts are avoided or mitigated at an early stage in the planning process;
- Ensure that potential benefits are identified and enhanced;
- Carry out environmental and social evaluations of projects in parallel with analyses of technical and economic feasibility;
- Ensure that decision makers are provided with information on projects environmental costs and benefits to complement information on technical and economic feasibility at key decision points in the development of the project;
- Ensure that all the interested and concerned parties participate in the process;
- Provide a framework to carry out mitigation and monitoring;
- Promote inter-sectoral and intra-sectoral linkages; and
- Conserve the social, historical and cultural values of the people and their communities.

The Malawi Environment Management Act (No.23 of 1996) describes environmental impact assessment as:

“A national instrument shall be undertaken for proposed activities that are likely to have an adverse impact on the environment and are subject to a decision of a competent authority.”

2.1 THE EIA PROCESS

The EIA process involves several stages or procedures (refer to Annex I). It begins with a determination by a licensing authority as to whether a proposed project is prescribed under the EMA. If not, no further action concerning EIA requirements need be undertaken. If it is, then a Project Brief must be submitted to the Director. Following are stages of the EIA process:

2.1.1 Screening: a process of determining what projects should be subject to EIA requirements. It is the first level of project evaluation and therefore helps to exempt projects that are not likely to have a negative impact on the environment. Typically, screening is undertaken by measuring or evaluating the proposed project, size, location, and potential negative impacts.
2.1.2 Scoping: establishes the principle issues to be addressed in an EIA. This is performed by a project preparation team comprising of the developer and a multi-disciplinary team of experts. The team should ensure that there is public participation in the EIA process. The main tasks of scoping are to:

1. Define the scope of work for the EIA;
2. Identify issues of concern to the key stakeholders/ interested and affected parties;
3. Provide guidance on the nature and scale of impacts likely to occur;
4. Determine the primary impacts for the EIA to focus on;
5. Identify any major environmental problems at an early stage to allow for design changes;
6. Determine skills and experience required in the multi-disciplinary EIA team;
7. Identify and analyse any feasible alternative project locations and designs;
8. Design the public participation/consultation plan; and,
9. Provide some indication of mitigation measures required.

2.1.3 The EIA Study

Using the ToRs approved by EAD, the EIA team will start with the following tasks:

- **Description of the proposed project:** describe the location, general layout, size, capacity, pre-construction and construction activities, staff, facilities and services, operation and maintenance activities, off-site investments, life span etc.;
- **Description of the environment:** present the environmental characteristics of the area, i.e. collection of baseline data;
- **Description of the legislative and regulatory framework:** discuss the legislation, regulations and standards applicable to the proposed project;
- **Determination of potential impacts of the proposed project:** Undertake impact identification, prediction, evaluation and interpretation;
- **Analysis of alternatives:** Describe the alternatives that were examined during the development of the proposed project;
- **Identification of mitigation and monitoring measures:** Describe the recommended mitigation, monitoring and management measures required, and preparation for implementing these measures;
- **Public consultation activities:** Design a programme to ensure all stakeholders and/ or interested and affected parties are consulted during the EIA process and their concerns are taken into consideration;
- **EIA reporting:** Document the EIA process and findings.
2.1.4 The EIA Report

The EIA report should include the following sections:

- **Executive Summary**: concise and comprehensive summary of the significant findings and recommended actions, with an emphasis on the expected impacts and management measures;
- **Introduction**: description of the developer, type of proposed project, location, background, reasons for the EIA, any constraints and limitation, the EIA team, etc.;
- **Project description**: description of the status of the project in the project cycle, details of the proposed project, alternative sites, history, design and implementation strategies, project inputs, outputs, products, process, type of equipment, maps, flow diagrams, photographs where required, summary of technical, economical and environmental features;
- **Environmental planning and design**: description of the environmental issues that were considered during planning and design of the project, description of issues that have been taken into account for minimizing negative impacts and enhancing positive impacts, compensating residual impacts, and management of these impacts etc;
- **Public consultation programme**: description of the objectives, methods used, and summary of results of public consultation activities undertaken during the EIA;
- **Compliance with environmental laws, regulation and company policies**: summary of legal and regulatory framework of relevance to the proposed project;
- **Environmental setting/Description**: description of the environmental setting of the proposed project and surrounding area e.g. climate, soils, geology, vegetation, fauna, land use, human populations, socio-economic status, cultural heritage and future trends;
- **Assessment of environmental impacts**:

  Description of the methodology used to determine the environmental impacts; description of the negative impacts; positive impacts; direct, indirect and cumulative impacts of the project on the physical and socio-economic features of the project area; discussion of the sources, causes and severity, likelihood, and significance of the impacts, and description of the recommended measures for avoiding or mitigating the negative impacts and enhancing positive impacts; summary of key impacts, mitigation and management measures etc.
3.0: Environmental Impacts

Discussed below are environmental impacts, associated with road development projects and proposed mitigation measures.

3.1 Air related Impacts

Road development has tremendous potential for degrading the air quality of the nearby air sheds if proper planning is not implemented. The major sources of pollutants are the emission form construction machinery and vehicles. The major pollutants are dust, gaseous emissions and particulate matter. These impart adverse impacts on human health, fauna and flora and the built environment. Guidelines for controlling air-related adverse impacts caused by road development projects are outlined below:

a) Select road alignments in such a way to avoid passing close to housing estates, schools, hospitals and workplaces;
b) Provide sufficient road capacity to avoid traffic congestion, even with projected increases in traffic flow;
c) Manage the traffic in such a way that vehicles operate efficiently at peak hours in populated areas;
d) Avoid placement of busy intersections, tunnel vents opening near housing, schools, hospitals and workplaces;
e) Avoid steep grades and sharp curves since they promote deceleration and acceleration;
f) Plant tall, leafy and dense vegetation between roads and roadside human settlements to filter pollutants;
g) Adopt national/regional strategic and regulatory measures to control air pollution;
h) Devise an air quality management strategy which should include policies, regulation and enforcement programme covering i) Vehicle emission standards as well as inspection and maintenance requirements; ii) retirement or retrofitting of high consumption and high polluting vehicles iii) fuel quality iv) management of traffic efficiency v) investment in much better mass transport such as buses and trains;
i) Improve local health care facilities to help treat pollution-related ailments;
j) Maintain close liaison among road engineers, environmental specialists and contractors;
k) Consult affected parties and encourage their participation in the implementation of mitigation measures;
l) Prepare environmental specification for contractors;
m) Enforce existing regulations for air quality control.

3.1.1 Dust

The obligatory use of heavy machinery in road maintenance and rehabilitation, especially on earthworks, can produce extreme dust. Passing vehicles and the progression of the dry season exacerbate the problem. Unchecked dust creation causes lung damage, crop damage, impedes visibility for drivers and workers and can be a nuisance for nearby villagers. Dust created by blasting at quarry sites can be harmful to human beings as well as fauna and flora.
**Recommended Mitigation Measures:**

- Water should be applied at regular intervals in high-traffic and/or high population-density areas. This provision should be a clearly billed item and the Client/Consulting Engineer should ensure that the activity is carried out as per the contract specifications.
- Dust masks should be provided for quarry workers, earth plant machine operators and the workers should be trained to wear them.
- Grading works should be carried out on materials with proper moisture content.

### 3.1.2 Exhaust Fumes

Workers and local people exposed to exhaust fumes on a daily basis may experience ill health. Carbon monoxide also contributes to climate change. Fuel wood is sometimes used for bitumen heating and production of asphalt.

**Recommended Mitigation Measures:**

- Machinery should be well maintained and the most modern machines should be used, where possible.
- Provide protective clothing to workers
- Locate production plant away from villages.

### 3.2 Soil Related Impacts

Major soil-related adverse impacts are soil erosion and modification of surface relief of borrow pits, slope failure and mass movements, sedimentation of road side drains and water bodies; loss of productive top soil and soil contamination. Soil related losses include farmers’ losing crop and land, fisheries income because of sedimentation of water bodies and water pollution, roadside dwellers lose households, properties and business sites.

Guidelines for minimizing soil-related impacts are outlined below:

- Avoid sensitive alignments, such as those, which encompass deep depression or steep hillsides;
- Minimize areas of ground clearance;
- Balance filling and cutting requirements through route choice to avoid the production of excess spoil materials thereby reducing the need for borrow pits;
- Avoid the creation of deep cut slopes and high embankments;
- Replant vegetation and trees in cleared areas and slopes as early as possible in the construction process before soil erosion and slope movement become advanced;
- Select vegetation and trees to serve specific bioengineering functions;
- Choosing the right time of the year, taking advantage of the rain season;
- Protect unstable slopes by concreting and geo-textiles, reinforced earth retaining walls and gabions, depending upon the local conditions;
- Shape the slope surface for maximum stability and vegetation seeding survivability;
• Carry out sowing on slopes manually or mechanically (hydro-seeding) in areas where access is difficult,
• Provide an appropriate drainage system and terraced or stepped slopes with vegetal cover to reduce erosion;
• Convert quarries and borrow pits into water reservoirs, aquaculture or wild life habitats;
• Convert spoil dumps into road side resting sites and picnic corners;
• Consult the public and encourage their participation in mitigating soil related problems;
• Maintain close cooperation and coordination among road agencies, road engineers, environmental specialists and contractors;
• Encourage public participation
• Prepare environmental specifications for contractors.

3.2.1 Mitre drains/ Culverts

Mitre drains and culverts may cause erosion of gardens when draining water away from the road.

**Recommended Mitigation Measures:**
- The catchments and terrain should be considered when determining the number and location of mitre drains/ culverts.
- Sensitisation of the affected communities on the proper land use outside the road reserve and use of soak pit for water harvesting.
- Enforcement of the road reserve regulations

3.2.2 Shoulders

Shoulders of the road get washed away in the rainy season if not properly sealed.

**Recommended Mitigation Measures:**
- Pave the shoulders according the recommended standards.
- Provide pedestrian walkways to reduce erosion and accidents
- Shoulders should be planted with grass (refer to 6.1.5)

3.3 Borrow Pits and Quarries

Borrow pits and Quarries after extraction of road construction material if not well reinstated may result in:

- the creation of stagnant water, hence mosquito breeding areas and an increased risk of malaria
- standing water is a drowning hazard for children and a flood hazard during the rainy season, cutting off transportation routes for residents;

**Recommended Mitigation Measures:**
- Each Borrow pit and Quarry must have a mining licence
- EIA studies should be conducted for each Borrow pit and Quarry and EMP implemented and monitored
- Consulting Engineers should enforce contract obligations for all contractors, consistently
3.4 Solid Waste

Road construction activities generate solid waste which has to be disposed off in accordance with accepted solid waste disposal methods and standards. Solid waste generated includes:

3.4.1 Rubble Disposal

Contractors dump waste rubble (bitumen or asphalt) anywhere, including at the side of the road, which represents a traffic hazard, or in gardens or borrow pits, which can impede production or rehabilitation.

3.4.2 Bitumen Spillage

Accidental bitumen spillage can contaminate the environment, including drinking water.

3.4.3 Solvent Disposal

Some workshops (that house road works machinery) dispose of hazardous materials such as oil and solvents in the grass or dug holes, which then seep into waterways and damage environmental and human health.

Recommended Mitigation Measures:

- For rubble, the procedures for environmentally acceptable disposal, including at licensed sites, should be detailed in the standard contract specifications.
- Environmentally acceptable procedures for workshop waste disposal should be developed and enforced by NRA.
- Cut to spoil within 5 km.

3.5 Noise

Road development has potential to degrade the quality of life if noise disturbance is not properly dealt with. In road development activities and transport operations, noise is generated from (a) construction machinery, (b) vehicles, (c) friction between vehicles and the road surface, and (d) driver behaviour. Noise associated with road development and transport operation activities degrades human welfare, sonically vibrates structures, and disturbs wildlife.

Assessment of the impact of potential road noise relies on an accurate evaluation of the baseline conditions, a thorough knowledge of characteristics of the proposed road development and good understanding of the composition of roadside dwellers (human beings and wildlife) and institutions and facilities (schools, hospitals, workplaces and recreational centres).

Guidelines for reducing/eliminating adverse impacts of noise caused by road development projects and transport operations outlined below:

- Avoid the noise problem by moving the road alignment or diverting traffic from noise sensitive areas using bypass roads and choosing an alignment, which minimizes steep and sharp corners, especially at sensitive locations.
• Provide barriers around noisy construction machinery and equipment to reduce construction noise.
• Maintain a smooth road surface without grooves and cracks in order to keep the noise level to a minimum.
• While designing a road, avoid steep grades and sharp corners to reduce noise resulting from acceleration, braking, gear changes and use of engine brakes by heavy trucks at critical locations.
• Erect noise barriers along both sides of the road especially at sensitive areas containing residential buildings, schools and hospitals.
• Incorporate noise protection measures in the road design, construction and operations stages.
• Include environmental specification in contract documents for contractors and machines operators for noise reduction in construction, quarrying and hours of operation, materials haulages routes, and permissible noise standards.
• Maintain close cooperation and coordination among road engineers, contractors machines operators and environmental specialists.
• Enforce legislation and regulatory measures to reduce noise impacts.
• Consult the local public and encourage their participation in noise mitigating measures.

3.5.1 Blasting at Quarries

Noise created by blasting at quarries and by loud machinery can cause long-term damage to hearing to humans and disrupt/displace wildlife.

Recommended Mitigation Measures:
• Ear protection to be supplied for workers, but it is not necessarily worn. Awareness and worker health and safety education may help.

3.6 Ecosystem-related impacts

Road development if undertaken without proper understanding of the various components of the natural biophysical environments can be accompanied by serious disruption to the ecosystem. Major adverse impacts include damage terrestrial and aquatic habitats, habitats fragmentation or loss, deforestation, loss of biodiversity, disappearance of reproduction and food zones for fish, aquatic and migrating birds, corridor restrictions, ecological disequilibria, contamination of biota, transmission of diseases and increase in poaching and hunting.

Guidelines for minimizing adverse impacts to the ecosystem caused by road developments are outlined below:

• Take the necessary steps to accomplish the following: i) inventory of biotic and abiotic resources, ii) estimation of the productivity of the ecosystem components (terrestrial and aquatic), iii) description of flora and fauna, iv) estimation of the ecological significance of the fauna and flora, wildlife and water bodies and ecosystem variables which are expected to experience changes; v) listing of physical, biological and chemical indicators to determine quantitatively ecosystem function and health; vi) listing of rare or vulnerable species of fauna and flora;
• Identify sensitive areas of the ecosystem early in the planning stage so that alternate routes and designs are considered;
• Where ever possible, locate development works more than 50 meters away from sensitive areas to avoid severe impacts on fauna and flora;
• Leave buffer zones of undisturbed vegetation between roads and watercourses;
• Avoid ground water recharge area;
• Avoid construction of major roads through national parks or other protected areas;
• Take advantage to twin new road corridors with previously established transport rights-of-way, such as railway lines;
• Modify the road cross-section to reduce the impacts on the ecosystem;
• Plant trees and vegetation in the roads right-of-way and adjacent areas to support local fauna and flora;
• Maintain close liaison with road engineers, construction supervisors, bioengineers, contractor and specialists;
• Take steps to provide animal crossings at convenient locations to assist migration of animals; fencing or barriers along the road side to reduce accidents; and culverted or bridge crossings for water.
• Prepare environmental specifications for contractors;
• Enforce existing ecosystem-related protection regulation.

Trees are often cleared along road corridor and for borrow pits. Also, large wood planks are still used for bridges and fuel wood is used in processes that support road maintenance work (e.g., bitumen heating). Consequently, biodiversity can be lost, human habitat degraded and climate change exacerbated.

**Recommended Mitigation Measures:**
• Try to preserve trees where possible.
• Replace timber decked bridges with reinforced concrete deck bridges.
• Replant trees. Add these as cost items in Bills of Quantities.

### 3.7 Sanitation

Sanitation is of utmost importance at the camp and working sites. The area of main concern is pit latrines as specified below.

#### 3.7.1 Latrines

Pit latrines constructed for use by temporary labourers who do not live in the area are sometimes constructed in ways/locations that can threaten drinking water supplies or are not filled in properly when they are no longer being used.

**Recommended Mitigation Measures:**
Ensure that the pit latrines are constructed in compliance with contract specifications and a reasonable distance from drinking water sources.

### 3.8 Water

Road development projects usually intersect drainage basins and subsequently alter or modify the local hydrology. Road development can lead to both alteration and modification to the surface water and ground water flow, water table fluctuations, and
water quality degradation. Guidelines for minimizing water resources related adverse impacts are outlined below:

- Avoid, where possible water catchments; aquaculture, swimming and bathing areas, recreation areas, irrigation and domestic water supply intakes by using alternative routes;
- Avoid alignments that are susceptible to erosion, such as those crossing steep slopes;
- Adopt mitigation measures that are technically feasible and economically viable in sensitive areas;
- Prepare detailed plans for the implementation and monitoring of EIA recommended measures during road construction and post-construction environmental monitoring for compliance;
- Consider relevant legislation and regulations as they affect drinking water intakes, irrigation water supply, wildlife habitat, flood control and drainage systems,
- Minimize the number of water crossings;
- Keep buffer zones of undisturbed vegetation between road sites and water bodies;
- Adopt appropriate protective measures such as vegetation cover, geo-textiles, settling basins; paving, infiltration ditches, stepped slopes, riprap, crib walls, retaining walls and intercepting ditches,
- Create replacement habitats for wildlife;
- Design the road drainage system to retain water in small dams or maintain a high water table by raising the inlets to drainage culverts in order to increase the availability of water for agriculture and domestic purposes; use by fauna and flora and for ground water recharge;
- Design retarding basins that reduce runoff peaks and improve the drainage of water in residential and farming areas and also in flood prone areas;
- Maintain close liaison among road engineers, environmental specialists and contractors;
- Prepare environmental specifications for contractors.

Road maintenance and rehabilitation activities require large supplies of water. This poses a particular problem in the height of the dry season. Local resources may get depleted if there are road works in the area. Not only is quantity an issue at times, so is quality. Run-off from stock piled materials and erosion can contaminate human drinking water, as well as impacting fish resources. Consequently, the biodiversity may eventually be lost and human habitat degraded.

**Recommended Mitigation Measures:**

Stockpile materials 15 km away from water resources.
Follow erosion mitigation measures as stipulated in annex 2.

3.9 Landscape

Any road development project can affect the surrounding landscape, which encompasses natural relief, vegetation, watercourses, structures and other objects of aesthetic value. A road development may destroy natural relics, change natural drainage patterns, destroy vegetation and trees, cause deforestation and desertification.

A well-designed road should fit in well with its surrounding landscape if its design reflects the principles of roadside landscape design. The principles should be applied
whether or not the area being considered is one of special aesthetic beauty. The roadside landscaping will serve to minimize not just visual disturbance to the landscape but more so disturbance to physical functioning of the natural and human ecosystem.

Below are guidelines for mitigating the adverse impacts of road projects on the landscape:

- Follow the natural relief as closely as possible to avoid major cut and fill zones in road construction;
- Reroute if possible to avoid sensitive areas;
- Minimize the cutting of trees and vegetation;
- Avoid recreational and sensitive areas while selecting road alignment;
- Avoid areas of historical interest or areas blocking off a scenic view of the landscape;
- Design the roadside landscaping to fit in well with local vegetation;
- Maintain roadside vegetation, slopes, and protective structures properly since they greatly affect the visual appearance;
- Reduce roadside eyesores by avoiding the use of too many types of noise barriers;
- Enforce regulations to control littering, billboards, and storefront advertising along the roads, especially at the entrance of cities or towns, in order to avoid unsightly proliferation;
- Draw separate environmental specifications for contractors to carry out re-vegetation and other works related to roadside landscape;
- Maintain close liaison among road engineers, environmental specialists, landscape architects and contractors;
- Enforce landscape protection related regulations.

3.10 Community activities

The construction of a new road, or the widening and improvement of an existing road, can cause split communities, disintegration of social activities, and disruption of traditional modes of transport, loss of roadside community business and degradation of the roadside environment.

Guidelines for avoiding/minimizing/mitigating adverse impacts of road development projects community activities are given below:

Follow recommended activities
- Avoid disruptions to social and economic activities that make the community vibrant and economically sound
- Follow a route far from any human settlement and sensitive area of ensure changes made to existing roads are minimal
- Minimize the splitting of a community by taking into account local movements at the road design stage and by making provision for improved crossings or alternative access routes for community interactions
- Provide signals, intersections, pedestrian underpasses, overpasses, service roads, and alternate arrangements for local traffic circulation
- Minimize the loss of roadside business activities through collaboration between the road agency and local organizations responsible for community activities and welfare
- Provide alternative arrangements where road improvements require the removal of some local activities from the right-of-way
• Cover roadside drains or purchase additional roadside land for the continued operation of roadside stalls, customer parking or pick-up areas for informal public transport services
• Mitigate the effects of bypassing local community business activities by providing service areas adjacent to the new routes and by encouraging local communities to make use of the new opportunities provided
• Take proper steps to discourage the migration of businesses that are essential for the passing travellers
• Design roads to encourage long-distance travellers to continue to use local businesses
• Identify various community activities areas early in the road project, planning the choice of alternative routes, the planning of temporary traffic diversions, and the location of work-site camps
• Draft environmental specifications for contractors, ensuring that work-site camps, construction works, and the lifestyles of construction workers do not have any negative impacts on the social, cultural and economic activities or nearby communities
• Give due consideration to legislation on property rights, expropriation procedures, and compensation requirements along with public participation.
• Arrange public hearings and encourage public participation.

3.11 Displacement and resettlement

Road development often requires the procurement of privately owned land. This procurement or acquisition of private land causes the displacement of families and households, resulting in economic loss and social psychological disruption for the affected individuals and their families. Naturally, the greater the number of people involved, the greater the disruption and loss. The actual valuation of these losses often proves to be a difficult task. The social and psychological impacts of displacement and associated costs are more complex and more devastating than anticipated. Social interactions among neighbourhoods can be disrupted and, in worst instances, can be destroyed completely by road projects. Typically, road projects cut across communities and thereby displace them; run through many properties such as post offices, police stations and utilities.

Monetary compensation poses a number of concerns in resettlement programmes. Most notable are the following: valuation of assets, property markets, timing of payments and manner in which compensation is paid.

Recommended guidelines for minimizing (by prevention, mitigation, and compensation) the adverse impacts of displacement and resettlement caused by road development projects are given below:

Guidelines

• Restore or replace any assets expropriated with adequate financial compensation.
• Wherever possible, restore or replace the assets at a minimum distance from the previous location to ensure the continuation of their economic activities under safe conditions for both customers and vendors
• Incorporate the cost of resettlement into the road project’s budget
• Prepare guidelines for displacement and resettlement of the affected people
• Prepare a resettlement action plan
• Prepare carefully the terms and conditions of the contents of the resettlement plan
• Draw environmental specifications in such a way as to ensure that construction works and traffic management do not disrupt nearby ecosystems
• Give due consideration to legislation related to local property rights, expropriation procedures, compensation and resettlement requirements, public participation and appeal processes
• Maintain close liaison among the affected people, road agency, engineers, contractors and environmental specialists.
3.12 Cultural heritage

A road project may have the following impacts on cultural heritage: damage of sites, structures and remains of archaeological, historical, religious and cultural value; damage to social value (spiritual, political, national or other cultural significances to a majority or minority group); degradation of the aesthetic value of cultural and religious institutions (churches, monasteries, mosques and temples) and historical monuments and shrines.

Guidelines for minimizing the adverse impacts by road projects on cultural heritage are outlined below:

- Identify and prioritize cultural heritage sites prior to route surveying;
- Pinpoint highly sensitive cultural heritage areas and archaeological sites;
- Avoid sensitive cultural heritage areas;
- Where ever possible, avoid any road alignment that cuts through known cultural heritage sites;
- Consider possible realignment if an important cultural heritage site is uncovered;
- Prepare a mitigation plan, which should include rules for archaeological supervision in the construction phase;
- Use common mitigation measures such as excavation, erosion control, restoration of structural elements and rerouting the traffic;
- In extreme cases, undertake salvage excavation to relocate artefacts or ruins from a site;
- Prepare a site management plan to identify conservation actions required and provide guidance on other measures like salvage and relocation;
- Establish monitoring and evaluation procedures;
- Incorporate specific clauses in contract documents to define the responsibilities of contractors and workers who uncover new sites or artefacts or who damage known sites;
- Initiate dialogue between NRA and Department of antiquities to avoid unnecessary damage or delays in the road project;
- To make the mitigation plan effective, include proposals for strengthening the legal framework and institutional capacities for the ongoing management of cultural heritage sites;
- Include the necessary environmental specifications in the contract document for contractors specifying the action-required and persons responsible;
- Incorporate additional clauses in the contract document with respect to any extra works that may be required for protection and preservation of cultural heritage sites;
- Consult the local public and encourage their participation in protecting and preserving cultural heritage sites.
3.13 Human health and safety

Road development is often instrumental in the transmission of diseases; the contamination of water supplies; air pollution; noise; road accidents caused by poor pavement and shoulder conditions; the creation of obstruction/unsafe conditions due to the presence of road side poles, ditches; trees; steep slopes and barriers; accidents caused by poor signage; markings, intersection layouts and traffic control systems; poor road side access and improper parking; and unsafe conditions due to poor or inadequate provisions for pedestrians, cyclists and other non-motorized users.

Safety is an issue that must be addressed since construction and operational related accidents result in death, injuries and damage to property, which are major public health problems and a significant factor to the national economy. Within the spectrum of road safety, unguarded construction machines, ill-planned construction activities; and the carelessness of machine operators may lead to fatal accidents. Landslides and collapse of unstable cuts above or below the road can prove fatal to road users who happen to be at a wrong place at the wrong time.

Guidelines for the protection of human health and for ensuring safety from the negative impacts caused by road development projects and transport are outlined below:

- Carry out a comprehensive awareness campaign to prevent outbreaks of communicable diseases;
- Screen and treat the affected persons
- Road alignments should avoid human settlements;
- Control dust by spraying water and cleaning the plant and vehicle;
- Plant dense stands of trees and vegetation along the road to control and filter other pollutants;
- Prepare a construction site management plan, which should explicitly focus on the treatment or safe disposal of waste water;
- Assign high priority to accident preventive measures;
- Assign higher ranking to the proper design of safety features to prevent accidents;
- Examine road design standards and safety equipment specifications to ensure that design details take into account of safety concerns and that specific safety features are correctly designed and installed;
- Draft a proper traffic management plan including details of road signs; markings; intersection layouts, canalization of traffic flows; access restrictions; footpaths; bus stops; and provision for non-motorized vehicles;
- Enforce the mandatory use of seatbelts; compulsory driver training and testing; prohibition and punishment of driving while impaired with drugs or alcohol;
- Traffic safety education and testing and inspection of all vehicles to comply with national safety standards;
- Improve road safety features for non-motorized vehicles;
- Provide proper safety features for vulnerable road users- pedestrians, cyclists- to reduce traffic congestion;
- Provide rest areas on heavily travelled roads to ensure the safety of all road users
- Develop a road safety programme to teach the people traffic safety rules;
• Follow strictly environmental specifications to cover correct practices for the installation of safety features e.g. guardrails, culvert end walls and road signs; as well as traffic safety requirements for the construction sites during operation and maintenance;
• Enforce laws, regulations and policies related to construction equipment and vehicle safety;
• Coordinate safety programme, policies, regulations and priorities with other agencies in the frame work of a comprehensive safety action plan;
• Enforce legislation to control air pollution and water contamination caused by activities in road projects;
• Consult local people and encourage their participation to protect public health and ensure safety;
• Maintain close cooperation and coordination among local residents, road agencies, engineers, safety officers and contractors.
4.0 Social Issues

Social issues also play a significant role in roads construction activities to ensure timely and professional completion of the projects. Critical social issues are discussed below.

4.1 AIDS Pandemic

The spread of sexually transmitted diseases, including HIV/AIDS may become the most severe impact of the influx of outside workers. In addition to this, an outside worker may remarry in the village, or have extra-marital affairs, which could lead to family break-ups and single parent children when the project is finished. In many cases, it is young teens that become pregnant and subsequently quit school to raise the child.

**Recommended Mitigation Measures:**
Mainstream HIV/AIDS in the road development activities by:
- Raising awareness and providing civic education to the workers and the surrounding community
- Supply condoms to workers.
- Holidays for workers to allow them to visit their families
- Workers should be encouraged to bring their families
- Provide guidance on good nutrition for HIV/AIDS infected workers
- Voluntary counselling and testing
- Abstinence

4.2 Traffic

Road works can cause traffic congestion and detours that may result in delays and increased vehicle operating costs. Once the road is improved, drivers travel at relatively high speeds, a situation that leads to traffic-related accidents.

**Recommended Mitigation Measures:**
- Intensify road safety campaigns

4.3 Encroachment

Gardens and houses that encroach on road reserve can cause problems when road works need to be carried out. Vendors can also illegally occupy the roadway, which is a risk to their lives.

**Recommended Mitigation Measures:**
- Enforce road reserve regulations with all the concerned stakeholders
- Road reserve should be physically demarcated
- Lobby the City/District to enforce their laws regarding vendor location.
- Empower Local Chief and Communities in enforcing road reserve regulations
- Provide land outside the road reserve for produce markets and other commercial ventures.

4.4 Theft/Vandalism

Workers and/or local community may steal the equipment and/or supplies (especially fuel), at a great financial loss to the Contractor. Vandalism also occurs if the workers are laid off, or if the villagers are unhappy about some aspect of the roadwork.

**Recommended Mitigation Measures:**
- Sensitise the surrounding communities through their local leaders
- Hire locally.
- A good pay package and benefits for the workers essential.
4.5 Signage

Improper or insufficient signage is sometimes used, which risks lives of workers and drivers during and after construction.

**Recommended Mitigation Measures:**
- Client should ensure that proper signage is provided at all times.

4.6 Public Participation

Lack of stakeholder consultation can lead to unsustainable practices, both environmentally and socially.

**Recommended Mitigation Measures:**
- Timely involvement of all stakeholders i.e. during the project preparation, implementation, monitoring and evaluation and decommissioning.

4.7 Dumping

Dumping of gravel or rock along the road may cause fatal traffic accidents, due to obstruction and visual intrusion.

**Recommended Mitigation Measures**
- Work on the dumped material immediately
- Ensure that the dumped material is well marked, particularly for night drivers.

4.8 Aesthetics

Road works often require disruption of the local environment, such as tree removal, topsoil removal, asphalt removal etc. which results in a loss of aesthetic appeal.

**Recommended Mitigation Measures**
- Remove the spoil sites and stock piles
- Cut down trees selectively and where possible plant trees
- Reinstate the natural environment where feasible
5.0 Environmental Management

To ensure that the mitigation measures for the adverse environmental impact identified in the EIA are being implemented, it is a requirement in EIA that Environmental Management and monitoring plans are made and constitute a major part of the EIA reports.

The EIA consultant has to pay particular attention to identifying and recommending measures or practices for avoiding, mitigating or managing negative impacts of the project, and for capturing or enhancing potential environmental benefits. As potential measures or practices begin to be identified, the EIA consultant brings them to developer’s attention for possible inclusion in the overall project plan.

In particular, the consultant prepares an environmental management plan for the construction, operation and decommissioning of the project. The consultant also estimates the costs of implementing this plan, including all capital, operating and training costs.

5.1 Management and Monitoring

A management plan consists of a set of measures to be taken during implementation of the road project and operation to: eliminate, offset, or reduce adverse environmental effects to acceptable levels. The plan identifies feasible and cost effective measures and estimates their potential environmental impacts, capital and recurrent costs, and institutional, training and monitoring requirements.

The plan provides details on proposed work programs and schedules to ensure that the proposed environmental actions are in phase with the construction and other project activities throughout implementation. The plan also considers compensatory measures if mitigation measures are not feasible or cost effective.

As part of an Environmental assessment report, EMPs provide a critical link between measures to mitigate adverse impacts and the integration of such measures during the implementation and operation of projects. They summarize the anticipated environmental impacts of projects and provide details on the measures, responsibilities and scheduling to mitigate these impacts, costs of mitigation and monitoring and supervision.

The format of an EMP needs to fit the circumstances in which it is being developed and the particular requirement for which it is designed to meet. For Category Prescribed Projects, mitigation measures and their means of implementation should be described in detail. Conversely, an EMP arising from an environmental audit might be summarized in a 1 or 2 page schedule. EMPs should demonstrate that proposed monitoring activities encompass all major impacts and how they will be integrated into project supervision.
The following aspects should be addressed within EMPs:

- **Summary of impacts:** Predicted adverse environmental impacts and their relationship to social impacts (and any uncertainties about their effects) for which mitigation is necessary should be identified and summarized.

- **Description of mitigation measures:** Each measure should be briefly described in relation to the impact(s) and conditions under which it is required. These should be accompanied by, or referenced to, designs, development activities (including equipment description) and operating procedures and implementation responsibilities. Proposed mitigation measures to facilitate public consultation should be clearly described and justified.

- **Description of monitoring program:** The EMP should identify monitoring objectives and specify the type of monitoring required; it should also describe environmental performance indicators which provide linkages between impacts and mitigation measures identified in the EA report -- parameters to be measured, methods to be used, sampling location and frequency of measurements, detection limits (as appropriate) and definition of thresholds to signal the need for corrective actions. Monitoring and supervision should be done to: ensure timely detection of conditions requiring remedial measures in keeping with good practice; furnish information and the progress and results of mitigation and institutional strengthening measures; and, assess compliance with relevant policies. Such arrangements should be clearly specified in the project implementation/operations manual to reinforce project supervision.

- **Legal requirements and bidding and contract documents:** The incorporation of detailed mitigation, monitoring and supervision arrangements into legal conditions and covenants is essential – where supervision identifies inadequacies in their implementation, such documents provide a basis for enforcing and reporting remedial actions. It is important to translate EMP requirements into bidding and contract documents to ensure that obligations are clearly communicated to contractors.

- **Implementation schedule:** The timing, frequency and duration of mitigation measures and monitoring should be included in an implementation schedule, showing phasing and coordination with procedures in the overall project implementation /operations manual. Linkages should be specified where implementation of mitigation measures is tied to institutional strengthening and to the project legal agreements, e.g. as conditions for loan effectiveness or disbursement.

- **Reporting:** Procedures for providing information on the progress and results of mitigation and monitoring measures should also be clearly stated. Recipients of such information should include those with responsibility for ensuring timely implementation of mitigation measures and for undertaking remedial actions.

- **Cost estimates:** These should be specified for both the initial investment and recurring expenses for implementing all measures defined in the EMP, integrated into the total project costs and factored into financing negotiations. As mitigating costs may occur at points during project implementation or operations, indications of cash flow should be provided.

It is important to capture all costs – including administrative, design and consultancy, and operational and maintenance costs – resulting from meeting...
required standards or modifying project design.

The development of mitigation measures, monitoring, institutional arrangements and scheduling can be aided by the use of matrices shown in the annexes below. These should be included in the EMP document.

5.2 Supervision of the EMP

Supervision of the EMP, along with other aspects of the project, covers monitoring, evaluative review and reporting and is designed to:

- Determine whether the contractor is carrying out the project in conformity with environmental safeguards and legal agreements;
- Identify problems as they arise during implementation and recommend to the contractor means to resolve them;
- Recommend changes in project concept/design, as appropriate, as the project evolves or circumstances change; and
- Identify the key risks to project sustainability and recommend appropriate risk management.

It is vital that an appropriate environmental supervision plan is developed with clear objectives to ensure the successful implementation of an EMP. In the case of projects involving major construction works, on-site supervision by local specialists may be the only feasible way of ensuring environmental due diligence. Such supervision also ensures that environmental clauses in construction contracts are adhered to on a regular basis.

5.3 Scheduling and reporting

Procedures for providing information on the progress and results of mitigation and monitoring measures should also be clearly stated. Recipients of such information should include those with responsibility for ensuring timely implementation of mitigation measures and for undertaking remedial actions.
6.0 Selected Best Management Practices

The practices described below are representative of best management practices to safeguard good environmental quality and prevent degradation of the ecosystems within construction areas. These are complimented with Annex 2: Environmental Checklists (SMEC 1998). The practices are as follows:

- Follow the design developed for each individual construction site to minimize erosion by properly timing and limiting ground disturbances operations.
- Construct and install culverts during periods when stream flow is low.
- Practice careful equipment operation during road maintenance works to minimize the movement of excavated material down slope as unintentional side impact.
- Compact the road base at the right moisture content, surfacing and grading to achieve the designed drainage system.
- Use straw bales straw mulch. Grass-seeding, hydro mulch and other erosion control measures and vegetation techniques to complete the construction project. These methods are used to protect freshly disturbed soils until vegetation can be established.
- Prevent slash from entering streams or promptly remove slash that accidentally falls into streams to avoid problems related to slash accumulation.
- Use turn-outs, wing ditches and dips to disperse runoff and reduce surface drainage from flowing directly into water courses.
- Install surface drainage controls to remove storm-water from the roadbed before the flow attains enough volume and velocity to erode the surface. Route discharge from drainage structures onto vegetated areas to allow water dispersion and infiltration into the ground.

6.1 Road surface drainage

These include but not limited to:

6.1.1 Pole and Ditch-Relief Culverts;

Culverts are place at varying intervals in road to safely conduct water from the ditch to the outside portion of the road. Culverts often need outlet and inlet protection to keep water from scouring away the supporting material and to keep debris form plugging the culvert. Energy dissipaters such as riprap and slash should be based on the size of the drainage area and should be able to handle large flows.
6.1.2 **Road Out-sloping and Grading**

Grade and out-slope roadbeds to minimize water accumulation on road surfaces. The practice minimizes erosion and road failure potential. Out-sloping involves grading the road that it slopes downward from the toe of the road to the shoulder – the slope should be about 3-4%.

6.1.3 **Ditch and Turn-out Construction**

Ditches should be used only where necessary and should discharge water into vegetated areas through the use of turn-outs. The less water ditches carry and the more frequently water is discharged, the better. Construct wide, gently sloping ditches, especially in areas with highly erodible soils. Ditches should be stabilized with rock and vegetation and outfalls protected with rocks, brush barriers, live vegetation or other suitable means. Runoff should be frequently diverted into culverts to avoid erosion or overflow.

Install appropriate sediment control structures to trap suspended sediment transported by runoff and prevent its discharge into the aquatic environment. The methods for sediment control include: brush, silt fences, riprap or filter strips.

Re-vegetate or Stabilize disturbed areas especially at stream crossings: cut banks and fill slopes are often difficult to re-vegetate. Properly condition slopes to provide seedbed, including rolling embankments and scarifying of cut slopes. The rough soil surface will provide niches for seeds to lodge and germinate. Seed as soon as possible after disturbance. Early grassing and spreading of brush are imperative on exposed soils on stream crossings.

Protect access points to the construction to the construction site leading from the main paved public right-of-way with crushed stones, wood chips or any suitable material to prevent soil or mud from being tracked into paved road. This will prevent tracking of sediment into roadways, thereby preventing subsequent wash-off of the sediment during storm events.

Construct stream crossing to minimize erosion and sedimentation: Avoid operating machinery in water bodies. Construction works within or adjacent to streams and water channels should be done during periods of low flows or less intense rainfall. Protect embankments with riprap, masonry headwalls or other retaining structures. If possible, install culverts within the natural streambeds; ensuring that the inlet is below the streambeds to minimize flooding upstream. Culverts should be firmly anchored and the earth adequately to prevent water leakages.

Properly dispose of organic debris generated during road construction or maintenance works. Organic debris should not be used as fill materials for construction since the organic material would eventually decompose and cause fill failure. Debris that accidentally fall into the stream should be removed before is terminated.

If the use of borrow or gravel pits is necessary during the construction works, locate quarries, gravel pits and borrow pits outside water channels and 50-meters away from flood lines. Excavation should not exceed the water table to avoid pollution of groundwater. Gravel mining directly from the stream causes adverse impacts including destruction of fish, sites, turbidity and sedimentation.
6.1.4 Degradation of Ecosystems

Best management practices to safeguard good environmental quality and prevent degradation of the ecosystems within construction areas. The practices are as follows:

- Follow the design developed for each individual construction site to minimize erosion by properly timing and limiting ground disturbance operations.
- Construct and install culverts during periods when stream flow is low.
- Practice careful equipment operation during road maintenance works to minimize the movement of excavated material down slope as unintentional side impact.
- Compact the road base at the right moisture content, surfacing and grading to achieve the designed drainage system.
- Use straw bales, straw mulch, grass-seeding, hydro mulch and other erosion control measures and vegetation techniques to complete the construction project. These methods are used to protect freshly disturbed soils until vegetation can be established.
- Prevent slash from entering streams or promptly remove slash that accidentally falls into streams to avoid problems related to slash accumulation.
- Use turnouts wing ditches and dips to disperse runoff and reduce surface drainage from flowing directly into watercourses.
- Install surface drainage controls to remove storm-water from the roadbed before the flow attains enough volume and velocity to erode the surface. Route discharge from drainage structures onto vegetated areas to allow water dispersion and infiltration into the ground.

6.1.5 ROADS ENVIRONMENT CONSERVATION BY MANAGEMENT

Road shoulders, culverts and bridges get eroded during rainy seasons by the surface run-off, or the high torrents from upstream. This can be effectively controlled or protected by applying the following management cultural practices:

- Road shoulders: they should be planted to Paspallum grass as early as rainy season starts so that by end of rainy season, the grass will be well established and spread covering the surface and roots providing good binding effect to the soil in the next rainy season. During planting, grass bunds of 30-45mm in diameter should be fixed at the spacing of 600mm on steep slope from top downwards. Spacing varies with the slope. This helps to check erosion as grass gets established.

Where the grass is planted at the end of rainy season, as per project schedules, efforts should be made to water it until fully established, possibly, six months, so the grass does not die and resources wasted, and erosion takes effect when rains come. When Paspallum grass is established it can be left without water and dry but
will not die. The grass will sprout with the first rains. The grass bunds should be maintained with the first rains to prevent rills forming, since the grass may not have fully covered the surface.

The grass near edges of bituminized surfaces or any carriage way should be cut so low to allow water to flow off the roads, otherwise seepage will cause the base of the be soft and unstable. This is the reason Vetiver grass is not recommended for road shoulders.

- Culverts and Bridges abutments: - After building walls, just on the edge of the wall, topside, should be planted to a row Vetiver grass, and then plant subsequent rows be planted 1.0m or 1.5m intervals depending on slope. Vetiver grass can also be planted on the steep sides of the road in addition to Paspallum grass. This should be planted from half-way down the slope. The rows of vertiver grass should be reinforced by grass bunds until it is established and cannot be washed down.

- When Vetiver grass is fully established, it has two control effects:

  a) The foliage will control the surface run-off and catch the silt; hence little or no soil will be washed down. Water may filter through but at a minimal velocity

  b) The root system can grow as deep as 2 – 2.5m, and this binds the soil or abutments that deep. This prevents the soil on the banks from being eaten away river flow, or soil cannot be moved easily water or seepage down the slope. It can hold roadside embankments from sliding down as far as it planted at closer intervals of even 0.5m apart between rows.

Vertiver grass should be planted with rains or be watered for nearly six months to allow root system develop. When fully developed it does not die in dry season, only leaves dry-off.
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Annexes
Annex 1  Flow Chart of the EIA Process in Malawi

*Based on TOR approved by EAD.  