REPUBLIC OF KENYA

MINISTRY OF ROADS, PUBLIC WORKS AND HOUSING

NORTHERN CORRIDOR TRANSPORT IMPROVEMENT PROJECT

FEASIBILITY STUDY AND DETAILED DESIGN FOR THE REHABILITATION AND RECONSTRUCTION OF THE LANET - NAKURU - MAU SUMMIT - TIMBOROA ROAD

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FEBRUARY 2004
ENVIRONMENTAL IMPACT ASSESSMENT OF LANET – NAKURU – TIMBOROA ROAD REPORT

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INTRODUCTION

Early in 1999, GIBB (Eastern Africa) Limited was appointed to undertake the Preliminary Design, Feasibility Study, Detailed Engineering Design and Contract Documentation for the Periodic Maintenance or Strengthening Works of the Lanet-Nakuru-Mau Summit-Timboroa Roads. Some sections of the existing bitumen surfaced road is in poor condition. The objective of the preliminary design/economic study and final engineering design component was "to identify the most appropriate and economically justified rehabilitation and periodic maintenance or strengthening solutions for the study road to provide for further design life of 10 and 15 years at the preliminary stage and cost, before a decision is made by MoRPW&H and IDA, on the solution to adopt for final design".

The objectives of the Environmental and Social Impact Assessment study (ESIA) are to identify the potential impacts on the physical, biological and socio-economic environment and subsequently propose appropriate mitigation measures for any negative impacts and enhancement measures for the positive impacts resulting from rehabilitation of the two roads.

The ESIA is based on field trips, document review and discussion with the project Engineers, Government officials, the World Bank and the local community. The project Engineers provided the proposed project details.

PROJECT SETTING

The Lanet – Nakuru – Timboroa road (A104) is located in Nakuru District of the Rift Valley Province. The Project Road is 97.3 km long and starts some 6 km before Nakuru town at Mbaruk (C69 Junction). It forms part of the Trans-African Highway giving access to Central Africa from the port of Mombasa. Other important centres along the road are Salgaa (km 35.5) and Mau Summit at km 59, Eldama Ravine/ Londiani junction township (Makutano) at km 73, and Timboroa centre at km 97.

POLICY, LEGAL AND REGULATORY FRAMEWORK

The policy of relevance to the proposed project is mainly the Environmental Policy. One of the primary objectives of the environmental policy is to ensure that economic development is sustainable and does not destroy the natural resources on which it depends. The Environmental Management and Co-ordination Act 1999 provides a framework legislation for over 77 statutes in Kenya that contain environmental provisions, and it also addresses cross-sectoral issues including environmental impact assessment, environmental audit and monitoring.

The World Bank classifies road rehabilitation, maintenance or upgrading projects under Category B. This category of projects requires a limited environmental assessment as the road alignment already exists and significant environmental impacts have already occurred during its initial construction and use.

PROJECT DESCRIPTION

Historical records indicate that the road was last constructed in the early 1980's. In the recent years the road surface condition (pavement) has deteriorated. The existing carriageway width varies from 6.5 m to 7.0 m allowing two lanes for traffic flow.

The design of the project road is described in detail in the Engineering Study Report. In general rehabilitation will involve strengthening of the road strictly following the existing alignment in most sections. At the start of the project a new carriageway, 7.8Km long will be constructed within the road reserve for the road section from Lanet to Nakuru town, and parallel to the existing carriageway. A minor re-alignment is envisaged. Additional works
include repair of structural defects, cleaning blocked drainage structures, installing additional new drainage structures, climbing lanes and restoring the road to its initial condition.

ENVIRONMENTAL BASELINE

The project road traverses Nakuru and Uasin Gishu Districts. The project zone of influence includes a population of approximately 500,000 inhabitants. The main economic activity in the project zone is agriculture. Other economic activities include livestock keeping, forestry and a growing industrial centre in Nakuru.

The project area experiences tropical climate with an average temperature of between 18°C and 30°C. The project road is located in an area with a bimodal rainfall pattern, with the wettest months being April to October and the dry season extending from December to February. The annual average rainfall increases from 900mm in Nakuru Town to 1350mm at Kamaara (km 67). The average altitude is 1880m above mean sea level.

The project road overlies mainly Quarternary and Tertiary volcanic rocks. These deposits comprise loosely consolidated boulder tuff with pumice layers and unconsolidated ash which emanated from Menengai. There are two major river/drainage crossings along the project road alignment, Rongai River (Km 35.6) and Molo River Bridge (Km 39.5).

ENVIRONMENTAL IMPACTS

The principal benefit to be derived from the rehabilitation of the Lanet - Mau Summit - Timbороа road will be improved road conditions resulting in efficient traffic flow with substantial savings in both time and cost. In the long run this will have beneficial effects on the national economy stemming from improved communications. No adverse environmental impacts are foreseen that are so severe and cannot be mitigated against such that they would prejudice the rehabilitation of the project road.

The study has identified that during construction, negative impacts on the environment are inevitable. The following significant adverse impacts are likely to result from rehabilitation of the road:

- Air and noise pollution from construction works;
- Vegetation loss and loss of topsoil mainly due to clearing of work sites and fuelwood demand by the construction workforce;
- Soil erosion due to earthworks;
- Visual intrusion caused by failure to rehabilitate materials sites;
- Contamination of water and health impacts resulting from work camp operations.

MITIGATION

The study has recommended measures to mitigate the adverse impacts and these include:

- Ensure that construction machinery are serviced and well maintained to reduce emissions and noise;
- Limit removal of vegetative cover;
- Control fuelwood collection by construction workforce;
- Plant grass and shrubs on road embankments;
- Reinstate and rehabilitate quarry and borrow sites;
- Carry out education and sensitisation programs on health issues such as hygiene and HIV/AIDS to the community and workforce.

MONITORING

Indicators for monitoring have been suggested. These include:

- The effectiveness of rehabilitation of quarries and borrow pits;
- The effectiveness of rehabilitation of construction camps;
- The efficiency of drainage structures;
- Compensation for Project Affected People;
- An assessment of the number and placement of HIV/AIDS awareness signs and community perceptions;
- Effectiveness of the HIV/AIDS awareness campaigns;
- Vehicle emissions, ambient air quality and noise surveys at selected locations along the project road.

The MoRPW&H has set up an Environmental and Social Unit (ESU) under its Planning Department. The ESU is best placed to ensure that monitoring does take place. However, the ESU is currently understaffed and will require additional staff to effectively monitor project impacts. There is also need for training and capacity building in matters related to environmental management within the Ministry of Roads, Road Users and Communities living along the project road.

The costs of various mitigation measures have been included in the total cost of the project in the contract documents. Environmental specifications for the contractor have also been included. These will ensure that the recommended mitigation measures are implemented. It is recommended that environmental audits / inspection be undertaken on a quarterly basis during construction and upon completion of the project to document the status and progress of implementation of mitigation measures.

Other costs related to the proposed project include:

- Fencing to deter encroachment onto the road reserve (KShs 3,892,000) approx. US$512,000.
- Monthly monitoring during the construction phase, US$ 1,100.
- Costs for monitoring impacts for a five year period during the operation phase, US$100,000.
- Costs for training and capacity building (KShs 3,040,600) approx. US$ 40,000.

CONCLUSION

In conclusion, it is important to bear in mind that on environmental grounds, the road has been in existence for a number of years and the environment along the road has been significantly altered and major impacts have already occurred. Additional disturbance due to its rehabilitation will therefore be relatively minor. It is recommended that this project proceeds and that the proposed mitigation and monitoring measures are enforced.
1 INTRODUCTION

1.1 General


The objective of the preliminary design/economic study and final engineering design component, as detailed in the Terms of Reference (ToR) was "to identify the most appropriate and economically justified rehabilitation and periodic maintenance or strengthening solutions for each of the study roads to provide for further design lives of 10 and 15 years at the preliminary stage and cost, before a decision is made by MoRPW and IDA, on the solution to adopt for final design". The requirements of the ToR for the next stage of the assignment were to "produce detailed engineering design and contract documents for each of the study roads based on the conclusion of the feasibility study as formally agreed with MoRPW in a form suitable for IDA assistance under International Competitive Bidding". A formal contract between GIBB and the Government of Kenya was signed on 23 April 1999.

This EIA report is presented in accordance with the Terms of Reference for the design of the Lanet - Nakuru - Timboroa Road (98 km). It presents the investigations and findings of the environmental impact assessment (EIA) and appropriate mitigation and support measures for the project. This report should be read in conjunction with Working Paper 1A, Traffic Studies, Working Paper No 1B, Axle Load Studies, Working Paper 2, Condition Survey of Structures & Drainage Systems, Working Paper 3B, Hydrological Studies and Working Paper 4, Preliminary Materials Investigation.

1.2 Project location

The Lanet - Nakuru - Timboroa road (A104) is located in Nakuru District of the Rift Valley Province. The Project Road is 97.3 km long and starts some 6 km before Nakuru town at Mbaruk (C69 Junction). It forms part of the Trans-African Highway giving access to Central Africa from the port of Mombasa. Other important centres along the road are Salgaa (km 35.5) and Mau Summit at km 59, Eldama Ravine/ Londiani junction township (Makutano) at km 73, and Timboroa centre at km 97.

The approximate chainages of some of the stations are:

1. Lanet – Nakuru Railway Bridge Km 0 – Km 16
2. Nakuru Railway Bridge – High Point Km 16 – Km 20.5
3. High Point – Molo River Km 20.5 – Km 37.6
4. Molo River – Narrow Bridge Km 37.7 – Km 66
5. Narrow Bridge – Timboroa Km 66 – Km 98

The location of the project road is presented in Figure 1.1.
1.3 **Scope of the study**

The major objective of the environmental impact assessment (EIA) was to conduct a study and document the positive and negative impacts of the project on the environment and recommend appropriate mitigative and support measures to minimise any undesirable effects and maximise the benefits that could result from the improvement of the project road. The analyses included, but were not limited by the following:

a) The role of the project in the national and regional development plans;

b) The preservation of areas and land use of particular value including agricultural and natural conservation areas, forests and other important natural resources, cultural and historic sites etc.;

c) Assessment of the direct impacts on agriculture and forestry, particularly the utilisation of fuel-wood and water;

d) The disturbance of vegetation and plans for re-vegetation;

e) The prevention of soil erosion and sedimentation;

f) The prevention of health hazards arising from the impounding of water and pollution of water courses and sources;

g) Measures for the rehabilitation of construction material borrow pits and quarries;

h) Health and sanitation for the road construction labour units;

i) The avoidance or mitigation of visual intrusion;

j) The assessment of the impact on demographic factors including the prevention of undesirable roadside developments and recommended regulations and measures to limit the negative impact on the adjacent communities and areas;

k) The impact of the project on women.

1.4 **Methodology of assessment**

In order for the EIA to be undertaken, current literature was reviewed and followed by field trips to the project area.

Reference was also made to the 1997-2001 District Development Plans for Nakuru and Uasin Gishu Districts.

1.5 **Alternative alignments**

The existing road corridor and other possible alternative routes were examined to determine the most appropriate alignment for the design. This was done on the ground and with the aid of aerial photographs (1:25,000) and topographic maps at 1:50,000.
From both a design and environmental perspective the existing road is the most obvious choice for upgrading and no other preferred routes or modes of transport were identified. An additional carriageway has been designed for the first section of the project road, a total length of 7.8Km allowing for a dual carriageway. As a result, according to the preliminary design, a minor re-alignment is envisaged. The details of the additional work will be discussed in the Final Report.


2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Policy framework

2.1.1 Environmental Policy

The Kenya Government's commitment to environmental protection and sustainable use of natural resources has been stated in all development plans since independence. The Sessional Papers and Presidential directives have also emphasised the need to conserve the environment and manage the available natural resources.

The 1997 - 2001 National Development Plan recognised the underlying causes of environmental degradation. It indicated that environmental management tools, including laws relating to the management of internationally shared resources, cross border issues, environmental economics and accounting and environmental impact assessments have not been adequately developed for effective environmental management.

The policy paper on Environment and Development (1999) emphasised the need for conservation and sustainable utilisation and management of the environment and natural resources. The Government's environmental policy aims at integrating environmental aspects into the national development plans. The broad objectives of the national environmental policy include:

- Optimal use of natural land and water resources in improving the quality of human environment;
- Sustainable use of natural resources to meet the needs of the present generation while preserving their ability to meet the needs of future generations;
- Integrate environmental conservation and economic activities into the process of sustainable development;
- Meet national goals and international obligations by conserving biodiversity, arresting desertification, mitigating effects of disasters, protecting ozone layer and maintaining ecological balance on the earth.

2.2 Legal framework

2.2.1 The Environmental Management and Co-ordination Act, 1999 (EMCA)

(a) Background

The 1999 Environmental Management and Co-ordination Act, received Presidential Assent on 6 January 2000 and was gazetted on 14 January 2000. The Act provides a framework legislation for over 77 statutes in Kenya that contain environmental provisions, and it also addresses cross-sectoral issues including environmental impact assessment, environmental audit and monitoring, environmental quality standards and environmental protection orders.

(b) Administrative structures

The Government has established the administrative structures to implement the Act. The National Environment Management Authority (NEMA) shall be the principal instrument of the Government in the implementation of all policies relating to the environment including:

- Issuing licenses for Environmental Impact Assessments (EIAs) effluents and emissions;
Monitoring and assessing activities to ensure that the environment is not degraded by the activities.

In addition to NEMA, the Act provides for the establishment and enforcement of environmental quality standards to be set by a technical committee of NEMA known as the Standards and Enforcement Review Committee (SERC).

(c) Requirements for Environmental Impact Assessment and Audit

The Act defines environmental impact assessment to be a ‘systematic examination conducted to determine whether or not a programme, activity or project will have any adverse impacts on the environment’. Part VI section 58 mandates the requirement for an environmental impact assessment.

The Second Schedule to the Act specifies the projects for which an EIA and Environmental Audit must be carried out. The broad categories that may be relevant to the proposed project include:

- All major roads;
- All roads in scenic, wooded or mountainous areas and wetlands.

Section 58 (7) states that the EIA ‘shall be conducted in accordance with the environmental impact assessment regulations, guidelines and procedures issued under this Act. These regulations were gazetted in June 2003.

(d) Environmental quality standards

A work plan has been set up by the SERC to include groups to draw up standards for water quality, air quality, waste, pesticides and toxic substances, noise, ionising and other radiation, and noxious smells. Until this is the case, environmental quality standards (where specified) under sectoral legislation will apply. Once the new standards have been set, these will supersede those specified under the sectoral legislation.

2.2.2 Sectoral legislation

Other laws pertaining to the environment and of direct relevance to this study include:

- The Forestry Act (CAP 385);
- The Agriculture Act (CAP 318);
- The Wildlife Conservation and Management Act (CAP 376);
- The Water Act (CAP 372);
- The Government Lands Act (CAP 280);
- The Traffic Act (CAP 203);
- The Mining Act (CAP 306).

In addition, numerous laws dealing with environmental aspects, such as health and sanitation are contained in the Local Government Regulations of 1963.

Kenya is also signatory to a number of international conventions on the environment ranging from the Convention on Biological Diversity (1992) to the UN Framework on Climate Change (1992), both of which could potentially be affected by the project, albeit over the longer term.
2.3 World Bank EIA requirements

2.3.1 World Bank Environmental Policy

The World Bank’s Operational Directive 4.01 on Environmental Assessments (now referred to as Operational Policy and Bank Procedure 4.01) requires that environmental assessments be undertaken in those categories of projects that have or are likely to have potentially significant impacts on the environment.

Under this Policy, projects are categorised as category A, B, C or D according to type, scale, location and anticipated severity of environmental impacts. The category indicates the scope and detail required for the EIA. These categories are presented in Table 2-1.

Table 2-1 Categories for Environmental Assessment

<table>
<thead>
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<th>Category</th>
<th>Requirement</th>
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<tr>
<td>A</td>
<td>A full (comprehensive) EIA is normally required as the project may have significant adverse environmental impacts that may be sensitive, irreversible and diverse. These are mainly new construction projects.</td>
</tr>
<tr>
<td>B</td>
<td>More limited environmental analysis is appropriate, as the project may have specific environmental impacts and mitigation measures can be more easily designed. Projects under this category entail rehabilitation, maintenance or upgrading rather than new construction.</td>
</tr>
<tr>
<td>C</td>
<td>Environmental analysis is normally unnecessary. Projects focus on education, family planning, health and human resource development.</td>
</tr>
<tr>
<td>D</td>
<td>Environmental projects, for which separate EIAs may not be required, as environment would be a major focus of project preparation.</td>
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According to these guidelines, road rehabilitation, maintenance or upgrading projects fall under Category B as the road alignment is existing and significant environmental impacts have already occurred during its initial construction. The environmental assessment focus for a Category B project is usually on the repair or rehabilitation of prior environmental damage and ensuring that the environment is not subjected to significant new negative impacts.

Nevertheless, there is likely to be a component of involuntary resettlement, particularly in the road section where a new dual carriageway and re-alignment is being considered. This suggests that the categorisation could be upgraded to A. However, the World Bank states “the presence of resettlement impacts in a project does not, in and of itself, trigger an environmental category “A” classification for the project. In fact only 40% of the Bank-financed projects involving resettlement that are currently under implementation are classified as Category “A” projects for environmental screening purposes. The requirements of OD 4.30 or the draft OP 4.12 are not contingent upon environmental categorisation. The project is categorised as an “A” on the basis of resettlement impacts if the environmental impact of the resettlement programme is substantial and irreversible” (The World Bank’s Environmental and Social Safeguard Policies, May 2002).
2.3.2 Other environmental and social safeguard policies

Other environmental and social safeguard policies of the Bank and their status in relation to the project are given in the Table below.

<table>
<thead>
<tr>
<th>Policy</th>
<th>Status</th>
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<tbody>
<tr>
<td>OP 4.04 Natural Habitats</td>
<td>Nakuru District has four major tourist sites: Lake Nakuru National Park, Menengai Crater, Mt. Longonot and Hells Gate. The road provides direct access to these sites but the sites are unlikely to be impacted by the project. Lake Nakuru National Park is 4Km south.</td>
</tr>
<tr>
<td>OP 4.11 Safeguarding cultural property</td>
<td>No structures of historic interest were found along the project road.</td>
</tr>
<tr>
<td>OP 4.36 Forestry</td>
<td>A few trees will be felled at the proposed new dual carriageway in Lanet - Nakuru section. Appropriate mitigation measures will be implemented. Otherwise no deforestation is needed to establish this project.</td>
</tr>
</tbody>
</table>
3 PROJECT DESCRIPTION

The project road commences approximately 6 km before Nakuru town at the Elementaita junction (D320/ A109 Junction) and ends at Timboroa trading centre. The total length of the road is 97.3 Km.

Historical records indicate that the road was last constructed in the early 1980's. In the recent years the road surface condition (pavement) has deteriorated. The existing carriageway width varies from 6.5 m to 7.0 m allowing two lanes for traffic flow. Over many sections, the carriageway is spalled with edge breaking and the width is reduced further. The existing road has no shoulders over most of the sections. This chapter describes the project components. The pavement rehabilitation approach for the various road sections to be adopted in this project are described in Section 3.2.

3.1 Project components

The design of the project road is described in detail in the Engineering Study Report. In general, rehabilitation will involve strengthening of the road, repair of structural defects, cleaning blocked drainage structures and restoring the road to its initial condition.

The pertinent features of the road design being considered are stated below:

- Rehabilitation of the 93.7 km road from Lanet to Timboroa;
- Constructing a new carriageway, for dualling the road section from Lanet to Nakuru town, 7.8Km long on the right hand side facing Nakuru town, a minor re-alignment is envisaged;
- The project road will follow the existing alignment, no re-alignments or straightening of curves are anticipated;
- The width of the bitumen carriageway will be 7m;
- The width of the shoulders may vary from 1.5 – 2.0m;
- Side drains and longitudinal ditches are existing along the project road. These are grassed and will continue to drain the rehabilitated road. Allowance has been made for cleaning silted outfalls;
- Junctions and accesses will be improved. In particular, the major junctions to Menengai/Njoro (D369/D318), Elburgon/Rongai (D318/D369), Njoro (D316), E258 to Mau Summit and to Kericho (B1) have been designed to incorporate a deceleration and storage lanes and are included in the Book of Drawings;
- Road safety signs will be included in the design;
- Rehabilitation of an existing climbing lane, new climbing lanes are also proposed at seven locations along the project road.

The chainages of these are as follows:

<table>
<thead>
<tr>
<th>Km</th>
<th>To (Km)</th>
<th>Side</th>
<th>Length (M)</th>
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<tbody>
<tr>
<td>13+800</td>
<td>19+290</td>
<td>LHS</td>
<td>5890</td>
</tr>
<tr>
<td>26+520</td>
<td>29+240</td>
<td>RHS</td>
<td>560</td>
</tr>
<tr>
<td>38+000</td>
<td>41+200</td>
<td>LHS</td>
<td>3200</td>
</tr>
<tr>
<td>41+200</td>
<td>48+100</td>
<td>LHS</td>
<td>6900*</td>
</tr>
<tr>
<td>48+100</td>
<td>51+820</td>
<td>LHS</td>
<td>560</td>
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<tr>
<td>53+910</td>
<td>55+840</td>
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<td>1930</td>
</tr>
<tr>
<td>57+780</td>
<td>58+430</td>
<td>RHS</td>
<td>650</td>
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* Existing Climbing lane.
Other details of importance are:

- The road reserve for this type of road is 30m from the centreline of the carriageway both sides;
- Material sites for road rehabilitation have been identified;
- No major earthworks are envisaged as part of the material will be re-used or recycled. Materials to be re-used by the Contractor will require prior approval by the Supervising Engineer;
- Workmen’s camps will have to be located around the major towns or trading centres during construction;
- Deviations created during previous rehabilitation projects will be used and where new deviations are required, these will be confined within the road reserve;
- The rehabilitation may involve:
  - Re-surfacing or overlay with bitumen at sections with good pavement;
  - Re-use of sub-base and addition of borrow materials at eroded sections.
- As part of the study, contract documents have been prepared. Costs for mitigation of construction related environmental impacts and specifications for environmental considerations have been included in the documents.

3.2 Pavement rehabilitation approach

3.2.1 Overlay at uniform section km 7.8 to 10.5

This is the existing dual carriageway section. The Engineering Report has recommended an overlay as a minimum for this section. The rehabilitation approach will entail the following:

- A thin layer of 30 mm should be milled to remove surface irregularities and provide a good bond with new layers;
- Shoulder and drainage works will then be undertaken followed by 150mm Dense Bitumen Macadam (DBM) overlay;
- 50mm asphalt concrete SUPERPAVE wearing course will be laid;
- Sealing the asphalt concrete surfaces with pre-coated chippings;
- The section from km 7.6 to 7.95 will be reconstructed to the same standard as km 13.8 to 59.3 below.

3.2.2 Sections km 0 to 7.8, km 10.5 to km 59.3

For uniform pavement sections between km 13.8 to 59.3 the following rehabilitation approach is recommended in the Engineering Report:

- The existing bituminous material will be milled to varying depths (130-180 mm) for hot process recycling, leaving a thin layer at the bottom of at least 50 mm in-situ to avoid contamination by lower materials;
- The remaining In-situ material will be scarified, material added to improve grading, then cement/lime improved and compacted to base quality;
- The milled bituminous material will be stockpiled, then bitumen, aggregates and recycling agents added if necessary to produce DBM to standard specifications, and laid as a lower base layer;
- Upper base and surfacing will be laid as SUPERPAVE layers;
- Sealing the asphalt concrete surfaces with pre-coated chippings.
3.2.3 Sections km 59.3 to 97.3

For uniform pavement section between km 59.3 to 97.3, the following rehabilitation approach is recommended:

- The existing graded crushed stone base will be removed and stockpiled, and contaminated material disposed of in the process;
- The remaining in-situ material will be scarified and compacted;
- The stockpiled graded crushed stone will be mixed with new material to improve grading, then lightly improved with cement and laid as base quality subbase;
- Base and surfacing will be laid as SUPERPAVE layers;
- Sealing the asphalt concrete surfaces with pre-coated chippings.

3.2.4 Special rehabilitation provisions

(a) Superpave layers

The Ministry has supervised a number of projects in which SUPERPAVE layers have been incorporated into the pavement. The Ministry’s experience will be invaluable during the design, trial, testing and laying of SUPERPAVE layers. The specifications contained in the bid documents are basically extracted from the recommended specifications for heavy duty asphalt for severely loaded sites as contained in the MoRPW&H/TRRL report “A Study of Bitumen and Bituminous Mixes for Road Pavements in Kenya, November 1996”, and which was adopted on the Voi-Bachuma Gate section of Mombasa-Nairobi Road.

(b) Recycling of bituminous layers

Recycling can be carried out using either a batch plant or a continuous mixer. Recycling of bituminous material in batch plants is achieved by superheating the virgin material and then adding the material to be recycled immediately after the drier or directly into the pugmill, heat transfer taking place during the mixing cycle. Recycling using continuous mixers involves introduction of the reclaimed material into the drum itself. Batch plants take 25% - 40% recycled material, while through modification, continuous mixers can take up to 60% recycled material. It has been assumed that the contractor will install a continuous batch plant capable of mixing up to 50% of the recycled material. The recycled material will be adequate to lay the lower base up to Mau Summit, but if smaller quantities of recycled materials are used then the recycled DBM layer can be extended beyond Mau Summit.

Recycling is an economic and environmentally acceptable alternative to disposal of these bituminous layers, but the process has to be carefully controlled at the milling and stockpiling stages to ensure materials are not contaminated. Further controls are required at the mixing stage to ensure that air pollutants, produced when vapourised bitumen condenses, are minimised and that the recycling process meets pollution standards.

A requirement for a Method Statement for this item is included in the Special Specifications.

(c) Reprocessing of graded crushed stone layers

It is intended that existing graded crushed stone base materials be re-used in the shoulders or as subbase on the main carriageway. Again this is an environmentally friendly solution, but will require careful control so that the contractor does not adopt construction methods which contaminate in-situ materials. Already contaminated materials are to be disposed of so that they do not adulterate other materials.
(d) **Improvement of in-situ layers**

After milling or removal of existing bituminous materials and graded crushed stone, the subgrade / subbase layers will be improved and compacted to increase the bearing strength of the *in-situ* layers. The amount of cement for improvement will be determined on site on a section by section basis. Due to the variability of the subgrade / subbase layers along the road, the homogeneous sections determined from the FWD testing should act as a good basis for determining the quantity required per section, and for issuing instructions to the contractor.

(e) **Re-use of surplus materials**

The re-use of existing bituminous and graded crushed stone materials could result in small quantities of surplus materials. Such materials can be used by MoRPW&H maintenance sections or in improving minor access roads. A provisional sum for re-use of these materials has been included in the Bid Documents, so that the surplus materials are not left in unsightly stockpiles.
4 ENVIRONMENTAL BASELINE CONDITIONS

The environmental baseline conditions of the project area can be sub-divided into bio-physical and socio-economic components which are described below:

4.1 Bio-physical environment

4.1.1 Topography and Climate

The alignment of the existing road can be sub-divided into the following main topographic sections:

1. Lanet – Nakuru Railway Bridge Km 0 – Km 16
2. Nakuru Railway Bridge – High Point Km 16 – Km 20.5
3. High Point – Molo River Km 20.5 – Km 37.6
4. Molo River – Narrow Bridge Km 37.7 – Km 66
5. Narrow Bridge – Timboroa Km 66 – Km 98

Over section one, the road maintains a constant altitude of about 1880m. Section two climbs gradually over 4 km. Over section three, the road is generally flat and straight to Molo River. Over section 4 the road climbs some 600m within the first 12km and continues to twist and turn for the remaining 16km. Over the last section the road runs along a watershed and ends at Timboroa where the altitude is 2700m.

The project road is located in an area with a bimodal rainfall pattern, with the wettest months being April to October and the dry season extending from December to February. The annual average rainfall increases from 900mm in Nakuru Town, peaking to 1350mm at Kamaara (km 67).

Table 4.1 Mean annual rainfall - Nakuru Timboroa Road

<table>
<thead>
<tr>
<th>Station</th>
<th>Mean Annual Rainfall(mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nakuru</td>
<td>900</td>
</tr>
<tr>
<td>Molo</td>
<td>895</td>
</tr>
<tr>
<td>Mau Summit</td>
<td>1100</td>
</tr>
<tr>
<td>Londiani Forest Station</td>
<td>1200</td>
</tr>
<tr>
<td>Kamaara Farm</td>
<td>1350</td>
</tr>
<tr>
<td>Makutano</td>
<td>1250</td>
</tr>
<tr>
<td>Equator</td>
<td>1200</td>
</tr>
<tr>
<td>Timboroa</td>
<td>1200</td>
</tr>
</tbody>
</table>

In Nakuru the mean maximum temperatures range between 25°C to 30°C, while the mean minimum temperatures vary between is 10°C to 18°C.

4.1.2 Air quality

The air quality in the immediate vicinity of the road is visually observed to be poor, particularly along the inclined road sections where black vehicle exhaust smoke can be observed to have deposited soot on road side vegetation.

The dominant air pollutants are likely to be lead, nitrogen oxides, sulphur oxides, carbon monoxide, volatile organic compounds (VOCs) and particulate matter (PM). Ozone and carbon dioxide may also be significant.
The use of leaded petrol in Kenya with an average content of 0.4g/l (Lovei 1998) is of concern, particularly for the 16km urban section from Lanet through Nakuru and the other settlements along the road. "Vehicular traffic, due to the use of leaded gasoline, remains the largest source of environmental lead pollution in many urban areas, often accounting for over 90% of all lead emissions in the atmosphere (Lovei, 1998)." Lead is a cumulative neurotoxin that impairs the brain development of children and has been connected to elevated blood pressure in adults which results in hypertension, heart attacks and premature death.

The use of high sulphur diesel (up to 1%) results in corresponding high emissions of sulphur dioxide which are known to cause respiratory problems and are responsible for acid rain.

In addition, the poor maintenance of vehicles and the illegal mixing of fuels, for example kerosene with diesel, results in emissions rich in black smoke. Thus, the combined effects of poor vehicle maintenance, illicit fuel mixing, leaded petrol and high sulphur diesel are likely to cause elevated levels of nitrogen oxides, sulphur dioxide, carbon monoxide and dioxide, volatile organic compounds (VOCs) particulate matter (PM) and ozone within a 30m corridor on either side of the road.

Noise levels are also likely to be significantly higher than ambient levels within the 30m road corridor.

### 4.2 Geology and soils

The road from Lanet to Timboroa overlies Quaternary and Tertiary volcanics. The start of the road at Lanet is in the base of the Great Rift, which in the vicinity of the road is dominated by Quaternary volcanics belonging to the Upper Menengai Series. Specifically, these deposits comprise of loosely consolidated boulder tuff with pumice layers and unconsolidated ash which emanated from Menengai in recent times (< 2 * 10^6 years). In addition, there are outcrops of earlier trachyte flows and welded vitreous ignimbrites, porphyritic trachytes and phonolites, some of which are Tertiary in age. The road continues through the Rongai Plain and other volcanics until km 37.6 at the Molo River.

Shortly after the Molo River the road crosses a number of north south trending faults (approximately eight) and the lithologies are dominated by older Tertiary volcanics (trachytes, quartz trachytes, agglomerates, tuffs and sediments) for some 10km.

At km 49 the road crosses into younger Quaternary Mau Summit sediments until the Mau Summit from where it passes into Tertiary welded tuffs and trachytes until Makutano. From Makutano to Timboroa the road mainly crosses the Tertiary Tinderet volcanics comprised of fine grained blue black phonolites.

There are four main soil types along the Lanet – Nakuru – Timboroa road.

<table>
<thead>
<tr>
<th>Km</th>
<th>Soil type</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 14</td>
<td>Phaeozems</td>
<td>Well drained / sandy clay loam</td>
</tr>
<tr>
<td>14 - 17</td>
<td>Lithosols</td>
<td>Excessively well drained / reddish brown to brown clay</td>
</tr>
<tr>
<td>17 – 38</td>
<td>Andosols</td>
<td>Excessively well drained / reddish brown to brown clay</td>
</tr>
<tr>
<td>38 – 61</td>
<td>Andosols</td>
<td>Well drained / reddish brown to brown clay</td>
</tr>
<tr>
<td>61 - 94</td>
<td>Nitisols</td>
<td>Well drained to moderately well drained / reddish brown to brown clay</td>
</tr>
<tr>
<td>94 – 98</td>
<td>Andosols</td>
<td>Well drained to moderately well drained / dark reddish brown to brown clay</td>
</tr>
</tbody>
</table>

4.3 Rivers, drainage and erosion

There are two major river/drainage crossings along the project road alignment as follows:

1. Km 35.6 Rongai River Bridge
2. Km 39.5 Molo River Bridge

The catchments in the area (some 59) are generally small (45 < 5 km²) and characterised by flat to very steep terrain. The three largest catchments are River Ngosorr (108.5 km²) Rongai (156.6 km²) and Molo (250.0 km²). Further details on the hydrology of the project area can be found in Working Paper 3B, Hydrological Studies.

The drainage was generally observed to be poor in the peri-urban and urban sections of the road and better in the rural areas. Near Mau Summit the steep slopes indicate the potential for high erosion without careful management as evidenced by erosion gullies.

4.4 Land use, flora and fauna

Urban, peri-urban and agricultural activities have greatly modified or eliminated the original plant and animal communities along the road alignment.

The first 16 km of the Lanet–Nakuru–Timboroa road is urban with little to none of the original flora and fauna communities remaining. From km 16 to km 25, the road passes through an cultivated agricultural zone which decreases in intensity towards km 25. On the Mau escarpment, forest predominates on both sides of the road with evidence of clear felling and burning all the way to Timboroa. The predominant indigenous species in Nakuru District are African Pencil Cedar (Juniperus procera), East African Yellow Wood (Podocarpus gracilior), Prunus africana, Dombeya getzenii and Aruninaria alpina. In addition, there are commercial forests of East African Cypress, pine and eucalyptus.

Both commercial and subsistence agriculture was observed along the project road and the main food and cash crops observed included wheat, maize, pyrethrum, vegetables and sisal. Livestock also plays an important role with cattle, sheep, goats and poultry observed.

Nakuru District has four major tourist sites: Lake Nakuru National Park, Menengai Crater, Mt. Longonot and Hell's Gate. The project road provides direct access to Lake Nakuru National Park, which is 4km south of the project road and Menengai Crater. It also provides indirect access to the other two sites through linkage with other major routes. The project road does not impact on the national parks directly.

Uasin Gishu District is home to the rare Rothschild giraffe, Faschson's hartebeest and the Sitatunga. However, the District Development Plan of 1997-2001 does not state where these animals can generally be found and purely comments that the district has potential for tourism.
4.5 Socio-economic environment

4.5.1 Population and migration

The road at Lanet starts in Nakuru District and crosses into Uasin Gishu District where it ends at Timboroa. Therefore, the road influences and affects the people living in both districts over and above the Trans African Highway traffic.

In 1997, the population for Nakuru was estimated to be 1.25 million and growing at a rate of 4.85% which would put it at over 1.5 million in 2001. In 1997, the population of Uasin Gishu was estimated to be 598,435 and growing at 3.7% which would put it in the region of 693,882 in 2001. Thus, the road will affect and influence more than 2.2 million in both districts (District Development Plan 1997-01).

More specifically the road will influence the people in Nakuru municipality, Njoro, Rongai, Elburgon and Molo divisions of Nakuru District and Ainbokoi division of Uasin Gishu which amounts to a predicted three quarters of a million people by 2001.

Neither district plans have information on in, or out-migration.

4.5.2 Status of women

Enrolment of women in adult literacy classes is higher than for men in all divisions except for in the municipality of Nakuru District. Enrolment of girls at primary school level is generally slightly higher than for boys, but this is reversed at secondary school level in Nakuru District.

No figures are given for adult literacy in Uasin Gishu District but the number of girls attending school is proportionally higher than boys at all levels. There is no special mention of women's issues in either District Development Plan. However, traditionally land is owned by men and culturally the man is the head of the household. This has a profound influence on the welfare of women in both districts.

4.5.3 Economic activities/occupation

The main economic activities in both districts are centred around agriculture, livestock and forestry with a growing industrial centre in Nakuru.

The leading cash and food crop in Uasin Gishu District is wheat. The district produces a third of the country's wheat. Other cash and food crops of importance in Ainabkoi division include maize, pyrethrum, vegetables, fruit and flowers. In Nakuru District the leading cash and food crop is maize with the number of hectares under wheat at less than half the number under maize. Other crops of importance include pyrethrum (Nakuru produces nearly 50% of the country's pyrethrum with the Kenya as the leading world supplier and insufficient supply to meet demand) sisal, coffee, tea, potatoes, millet, vegetables and fruit.

Income from all types of livestock (except pigs) steadily rose over the period 1991-1995 for Uasin Gishu except in 1995 where there was a marked depression in all activities due to insecurity. In Nakuru District all livestock production and sales were generally stable or showed slight increases or decreases from 1993-1995.
Forestry is an important activity in Nakuru District. There are 98 registered saw millers of which 10 are large scale in the District. Timber harvested has decreased from 1991 to 1994 (134,042 m³ to 105,793 m³) with no explanation given while fuelwood production has fluctuated from 5,603 m³ in 1991 to 73 m³ in 1992 to 2,320 m³ in 1994.

Forestry is the second most important activity after agriculture in Uasin Gishu District. Forests cover 31,496 ha (10% of the district area) of which 46% is indigenous, 46% plantation, 3% bamboo and 1% grassland trees. No figures or statistics are provided on harvesting rates, fuelwood use or licensed large and small scale operators.

Visual observations suggest that the forests are being exploited rather than sustainably utilised with large areas being clear felled and numerous incidents of burning.

Small scale and informal trading (food and beverage production, furniture making, metal work and sewing) is important in the emerging centres (Salgaa market) along the alignment.

4.5.4 Health and education

The top three diseases for both Nakuru and Uasin Gishu Districts are:

1. Respiratory diseases;
2. Malaria;
3. Skin diseases.

In addition, HIV/AIDS is of concern. However, Nakuru District reported only 362 and 364 cases in 1994 and 1995 while Uasin Gishu District reported a general incidence of 4.3% in the rural areas and 9.9% in the urban areas (the latter statistics were not given in relation to a particular age group or period of time).

Nakuru, Molo and Ainabkoi division have hospitals and the road provides direct and indirect access to these facilities. Rongai, Njoro and Bahati divisions only have a health centre in the event of an emergency. Furthermore, the District Development Plan for 1997-2001 clearly states that the equipment in all facilities is inadequate, scanning can only be done in Nairobi and there is a need for general rehabilitation including provision of vital facilities including an intensive care unit at Naivasha District Hospital.

The average ratio of primary to secondary schools is 4:1 for both Nakuru and Uasin Gishu Districts. Literacy levels, certainly adult literacy levels are said to be increasing in Nakuru District with the provision of adult literacy classes and the enrolment of over 4,000 adults in 1995. There is no discussion of adult literacy in the Uasin Gishu District Development Plan for 1997-2001.

The alignment provides direct access to at least 5 schools and most probably indirect access to a number of learning institutions.

4.5.5 Non-motorised transport

The number of pedestrians and bicycles using the existing routes is high in particular within the urban section of the road. Preliminary findings suggest that during peak hours over 500 people cross the road in places where there is no footbridge and over 1000 people walk along the road verge.

Bicycle counts indicate that the number of bicycles varies from a tenth of the number of cars (where vehicles have been sub-divided into six different categories) up to more than half the
traffic along the road. Often the number of bicycles are approximately half the number of cars and therefore represent about 8 – 16% of the traffic along the route.
5 IDENTIFICATION AND PREDICTION OF IMPACTS

Any road project impacts the environment and community through which it passes. These impacts can be sub-divided into positive and negative impacts. It is important to consider the duration of the impact and at what phase of the project it occurs, i.e., is it short term (in the construction phase) or long term (over the life of the road) and is it direct (removal of top soil) or indirect (improving access to neighbouring areas). The impact of the environment on the road should also be considered.

It is important to note that for the project road, a paved road already exists and has existed for over 15 years. Few changes are proposed to the current alignment and this significantly reduces the impact of the road on the surrounding environment.

5.1 The positive impacts

5.1.1 National / regional economy

The Lanet - Nakuru - Timboroa road forms part of the Trans African Highway providing access from north to south in Kenya and to a number of east and central African countries (Rwanda, Burundi, Democratic Republic of Congo, Uganda & Sudan) from the port of Mombasa on the Kenyan coast.

Road transport is the dominant form of transport in Kenya. It accounts for approximately 80-90% of the countries passenger and freight movements (excluding pedestrian transport) and provides the only access to most communities.

The project road passes through important agricultural and forestry zones. Rehabilitating the road will reduce people’s transport costs considerably and there will be important time savings. This is a significant positive impact and will be particularly valuable to the Trans African traffic.

5.1.2 Occupation / economic activities

During the re-construction phase there will some employment opportunities for both skilled and unskilled labour related directly to the road. Indirect opportunities could also arise from increased prospects for trading and the supply of food and water to the construction team.

Over the design life of the road, the improved accessibility to and through the area is likely to impact positively on employment opportunities. The overall impact is considered to be significant and positive.

5.1.3 Population and migration

As the immediate population in the area of the road was expected to exceed three quarters of a million by 2001, and the population of both Nakuru and Uasin Gishu Districts was expected to exceed 2.2 million by 2001. The impact of an improved road will be significant and positive on the people living in the area.

No direct correlation has been established between an improved road and migration. However, it is likely that an improved road could result in in-migration from the neighbouring divisions, particularly to Nakuru town as well as the other smaller centres.
5.1.4 Status of women

The direct benefits from an improved road to women are the obvious increased opportunities in agriculture, forestry and trading. The indirect benefits include better access to medical clinics and hospitals and time savings for a variety of activities for both women and children. More subtle benefits include increased opportunities for women to gradually improve their circumstances. In addition, some of the traditional roles are likely to be dropped and women in general are likely to become more assertive and have the ability to exert more direct control over their lives. This is considered to be a moderate positive impact.

5.1.5 Health and education

An improved road will provide easier and quicker access to health and educational facilities. The impact is considered to be moderate and positive.

5.2 The negative impacts

5.2.1 Accidents

The incidence of all types of accidents (pedestrian-bicycle-vehicular) will increase significantly as a result of the larger volume and faster speeds attainable of vehicular traffic on the improved road. This impact is considered to be significant and negative but if adequate facilities for pedestrians and cyclists are provided, this could have a positive impact.

5.2.2 Air and noise pollution

During the construction phase dust, noise, vibration and air emission levels will increase with the use of construction machinery. The impact is considered to be moderate and negative in the urban sections of the road and only slightly negative in the rural sections of the road. Over the life of the road the volume of vehicles is likely to increase which will result in a corresponding increase in emissions. Owing to the urban and numerous steep sections of the road, this effect will be marked and could potentially negatively impact anyone living or working close to the road. The potential impact at this time is considered to be moderate to significant and negative, and should be monitored over time.

In addition, the increase in traffic volume will result in a corresponding increase in noise and vibration. This is likely to result in a significant impact to the buildings that are built close to the road, which at the present time generally occurs in Nakuru town and is beginning to occur in some of the smaller centres.

5.2.3 Diversion routes

It is envisaged that diversion routes will parallel the existing road during the upgrading phase or alternative alignments will be used. As a result some vegetation clearance and material stabilisation may be necessary. The potential impacts of poor diversion routes are significant and negative.

5.2.4 Impact on flora and fauna

The proposed project road follows the existing alignment. There will be no re-alignments or straightening of curves hence destruction of large areas of vegetative cover is not anticipated. However, some trees will be felled along the section where a new carriageway will be constructed. In addition, vegetation encroaching on roadsides will be cleared to improve sight distance. It is unlikely that this vegetation has any special conservation value, therefore, the impact is expected to be minimal as most of the vegetation is secondary in nature.
Construction projects also involve the establishment of work camps, crushing plants and exploitation of borrow sites. These will involve the removal of vegetative cover. Some of these areas are habitats for different insects, butterflies, rodents and birds. Nevertheless uncontrolled clearing of vegetation by the contractor should not be permitted as vegetation loss may cause long term negative ecological impacts.

During construction, in the absence of alternative sources of energy, the labour force relies on wood fuel. The increase in traffic volume during operation, is likely to increase trade along the alignment, which in turn could adversely affect the forests with the sale of unregulated charcoal (reference photograph 1 with charcoal at Ksh 250 per sack) and timber.

5.2.5 Landscape modification / quarries and borrow pits

During the re-construction phase a number of borrow pits and quarries will be opened up as listed in the Preliminary Materials Report, 2000. There are at least 17 potential borrow pit sites and 9 potential stone quarry sites along the Lanet – Nakuru – Timboroa road.

The potential borrow pit and quarry sites were generally observed to be free of homesteads, buildings and other environmentally sensitive structures. Photograph 2 illustrates a potential borrow pit site (MS 2).

If the selected borrow pits and quarries are not rehabilitated after use the impact will be significant and negative.

Linked to the landscape modification resulting from exposed and exhausted borrow pits and quarries is the development of pools of stagnant water after rainfall events. These form ideal habitats for mosquitoes, particularly the malarial mosquito (*Anopheles* spp). Since malaria is the second most prevalent disease in both Nakuru and Uasin Gishu Districts, the potential impact is significant and negative.

5.2.6 Soil erosion

Erosion can be caused by earthworks during construction especially at borrow sites, embankments and earth dumping areas. This can result in loss of topsoil, which has the resultant effect of reduced productivity in arable lands.

5.2.7 Public health impact and social change

During the construction phase, work teams can bring social upheaval to small rural communities such as those found along the alignment. Construction camps also known as work-camps usually include workers’ living and eating areas and the grounds where equipment is stored and serviced and where materials are stockpiled. These camps bring a temporary influx of people in an area. This may stimulate business in the project area and also propagate the spread of sexually transmitted diseases such as HIV/AIDS due to sexual interactions between the project workforce and the local community.

Local services such as health services, water supplies sanitation and waste disposal can be over stretched by the sudden increase in population. Improper sanitation arrangements at the labour work-camp can cause contamination of groundwater and pose a major health hazard, contributing to the local community health problems such as diarrhoea, cholera and typhoid.

Over the life of the road, the improved accessibility to the area will continue to attract increased levels of crime and lawlessness and this is likely to be accompanied by a gradual breakdown in the traditional social structures. This impact is considered to be potentially slight and negative as the paved road has existed for a number of decades.

5.2.8 Water and soil contamination

During construction phase there will be a deterioration in the water quality of the surrounding area, mainly as a result of the spread of soil particulate matter and sedimentation particularly
in the three rivers that the alignment cross. The impact will be more significant and negative during either of the two rainy seasons and is likely to be compounded by human activities, especially agricultural activities.

If the construction camps are sited near water courses or close to the forested areas, pollution from waste oil or chemical spills would be more significant than if the sites are located away from water courses.

Over the life of the road, there is the possibility that there will be a number of pollution incidents, such as an oil or chemical spill.

In places the existing paved road has scour channels on either side of the road, which have been caused by incidents of intense tropical rainfall. The effect will be similar for a reconstructed road, if it is not properly maintained. The potential impact is considered to be moderate and negative.
Table 5.1: Summary table of the potential positive & negative impacts

<table>
<thead>
<tr>
<th>IMPACT ON</th>
<th>CONSTRUCTION</th>
<th>LIFE OF ROAD</th>
<th>MITIGATION REQUIRED</th>
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<tbody>
<tr>
<td>National/Regional Economy</td>
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<td>φ</td>
<td>required</td>
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<td>Population and Migration</td>
<td>φ</td>
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<td>Status of Women</td>
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<td>Economic Activities / Occupation</td>
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<td>Social Change</td>
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<td>Water and soils</td>
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Φ potential positive impact
Ι potential negative impact
≤ mitigation required
6 ENVIRONMENTAL MITIGATION AND MANAGEMENT PROGRAMME

In the preceding Section, where a negative impact has been predicted, appropriate mitigation measures are recommended. In addition, indicators for monitoring during construction and operation phases are suggested.

6.1 Mitigation during construction

6.1.1 Responsibility of the Contractor

Many of the potentially significant negative impacts identified in the EIA relate to the reconstruction phase of the project and hence to the engineering contractors. Mitigative and support measures are therefore, best achieved through the incorporation of suitable clauses in the construction documents, which are enforced by the Supervising Engineer.

Clauses to be detailed by the Design Engineer should include the following:

1. Contractor sites should at all times be kept clean and tidy and appropriate measures should be taken for the storage, handling, transportation and disposal of all waste material. A proposed 'waste management plan' should be forwarded to the Engineer for approval prior to commencing work. Bio-degradable waste should be composted on site while appropriate measures for waste minimisation and recycling should be applied to all other wastes (plastic, glass, metal, paper, textiles, timber, asphalt, waste oil, lubricants and chemicals). Where possible burning of waste should be avoided.

2. The Contractor should be responsible for the provision of adequate sanitary facilities for his/her workforce and should not allow the discharge of any untreated sanitary waste into the groundwater or any surface watercourse. Proposed sanitary arrangements should be forwarded to the Engineer for approval prior to commencing work (an absolute minimum of at least one WC per 25 people – Plumbing and Engineering Services Design Guide-UK, 1988).

3. All vehicles and machinery shall be maintained in accordance with the original manufacturers’ specifications and manuals to avoid excessive noise, vibration and vehicle exhaust pollution.

4. All asphalt plants shall be operated and maintained in accordance with the original manufacturers’ specifications and manuals and in such a manner as to minimise the emissions of hydrocarbons and particulates.

5. The Contractor should douse all exposed dirt surfaces with water to reduce dust levels.

6. The Contractor shall take all reasonable measures to prevent spillage and leakage of materials likely to pollute any watercourse. In addition, construction camps should be sited away from water courses and construction teams should be guided on environmentally friendly operating procedures.

7. Basic training in construction health (specifically the hazards of commercial sex in relation to sexually transmitted diseases such as HIV/AIDS) and safety, first aid and the environment (social concerns specific to the area and waste management) should be provided to the construction team. Priority should be given to employing people from the area in order to boost the local economy.
8. Breeding sites for water-borne diseases should be eliminated or minimised, such as the stagnant water pools that develop in used borrow pits and quarries. This is the responsibility of the Contractor and should be ensured by the Engineer. All borrow pits shall be re-graded, covered in topsoil and re-vegetated, preferably with indigenous species. In addition, all quarries should be rehabilitated. Borrow pits and quarries should be rehabilitated immediately after, or concurrently with use.

Rehabilitation should aim to restore the vegetation to its original condition, or preferably to improve on, the original vegetation complex found at borrow pit and quarry sites. A mixture of indigenous grasses, shrubs and trees should be planted, with the emphasis on trees for ornamental, wood-fuel and other agro-forestry uses. Consideration should be given to planting the African Pencil Cedar (*juniperus procera*), East African Yellow Wood (*podocarpus gracilior*), Rosewood and East African Olive (*Olea Africana*). The rehabilitation programme should be executed by the Contractor in collaboration with the Forestry Officer for Nakuru and Uasin Gishu Districts.

Payment of the Contractor should be tied to evidence of sustainable seedling/tree growth. Typically, rehabilitation programmes are executed, but without supervision or participation of the local community, which results in tree death after a short period of time, usually less than one year.

If external quarry suppliers are used, provision should be made in the contract documents to ensure that they are obliged to have a rehabilitation plan and exercise due care for the environment as detailed in the above points. Photograph 3 illustrates bitumen drums directly placed on the soil with no hardstanding. In essence, external suppliers should comply to the same regulations as the Contractor.

9. Diversion routes should be no more than 6 m wide and should be within the road reserve. During the re-construction phase, any trees felled should be replaced, preferably with indigenous species. Any diversion routes which have to be outside the road reserve should be replanted, preferably with a mixture of indigenous species and with the advice of the Nakuru and Uasin Gishu Forest Officers.

10. During re-construction activities every effort should be made to minimise and reduce accidents with awareness training and clear procedures and signage placement.

11. Roadside drainage should not be discharged directly into cultivated land unless requested. In instances where it cannot be avoided, appropriate mitigation measures should be introduced such as the concrete lining of outfall channels at regular intervals to minimise the effect of flowing water and to spread the load between a number of subsistence farmers.

12. Consideration should be given to planting trees, preferably indigenous trees along the length of the road where they haven't already been planted and away from utilities (power and telephone lines) at regular intervals, such as every 15-20 metres. The road shoulders that are not paved or gravelled should have a ground cover of grass planted, again preferably indigenous grasses. Re-grassing should be carried out in a phased manner to minimise erosion and as work on the road proceeds.

13. Re-construction activities should not be undertaken during the rainy seasons. If it is not possible to avoid carrying out construction activities during the rainy season, every effort should be made to minimise soil erosion and siltation of the seven water courses that the alignment crosses.
6.2 Mitigation for impacts over the life of the road

6.2.1 Accidents

Billboards should be placed at regular intervals indicating the required speed limit for a particular stretch of road and they should be vandal proof and clearly visible.

In order to minimise accidents involving pedestrians and bicycles with vehicles, they should be provided with a separate, segregated path and cycle-way. Since the cost of providing a segregated path and cycle-way can vary enormously further research will be conducted during the detailed design stage, particularly for the urban centres and along the flatter road stretches. A ball park figure of US$ 18,000 per km can be used to provide an indication of cost.

In addition, bus lay-bys should be improved throughout the route, but particularly at Lanet, Nakuru, Salgaa Market (photograph 4), Mau Summit and Timboroa.

The Kenya traffic police should perform regular patrols at different locations along the road during the operation phase, to check on traffic speeds and the effectiveness of the road safety information and education campaigns.

6.2.2 Air quality

Further research should be done into the air quality particularly along the urban sections of the Nakuru – Lanet – Timboroa road.

Two types of survey should be undertaken: one on vehicle emissions and one on the ambient air at given distances perpendicular to a centre point in the road. The most cost effective system for measuring air pollutants currently available is based on the colorimetric indicator tubes. Measurements should be carried out for nitrogen oxides, carbon monoxide, sulphur dioxide and ozone. An approximate cost for a five day survey would be in the order of US$ 5000.

Emission testing should be initiated during the annual vehicle inspection and vehicle owners/operators should be reminded that regular services minimise particulates and other gases. It has been shown in a number of studies that a relatively small number of vehicles contribute a disproportionate amount of pollution. For example, in 1991 a study in the UK showed that 12% of the vehicles were responsible for half the CO emissions (after Harrison 1996). This finding is likely to be mirrored along the project road.

People should be discouraged from building houses close to the road due to the insidious effects of both air emissions and noise pollution.

At the strategic level, consideration should be given to phasing out leaded petrol and high sulphur diesel in Kenya. In addition, tax incentives should be provided for the introduction of unleaded petrol, low sulphur diesel and for the purchase of cleaner vehicles such as those with catalytic converters.

6.2.3 Flora and fauna

In order to mitigate any illegal trade in tree products (timber, charcoal, woodfuel) and/or any other natural resources, there needs to be consultation with other Government Departments, such as the Forest Department and Kenya Wildlife Service on how best manage the problem. In general terms the cessation of any illegal trade, involves quantifying, legitimising and regular monitoring of it.

Special measures should be taken to preserve the forest zones at along the project road.
6.2.4 Social change and environmental information campaign

The re-construction of the road should be accompanied by periodic environmental information campaigns on:

- road safety;
- promotion of bicycle usage, particularly over short distances (0-10 km) as an environmentally friendly mode of transport;
- pollution reduction (both noise/vibration and exhaust emissions) through the regular service and maintenance of vehicles;
- the prevention of careless waste dumping such as used plastic bags (photograph 5) along the road (possibly encouraged with the use of 'No littering' signs accompanied by a fine of Ksh 1000 or more);
- public health issues and specifically the hazards of commercial sex in relation to sexually transmitted diseases such as HIV/AIDS.

The campaign could be initiated through the District Development Office in collaboration with interested NGOs working in the area. Different media (radio, television and newspapers) should be used.

6.2.5 Water quality

Regular maintenance of the main bridges / culverts and all other side drains should be carried out (reference photograph 5). Consideration should be given to linking this in with other awareness programmes such as terracing of steep land and soil erosion minimisation through the use of appropriate vegetation (sisal fences) and structural traps (water catch pits).

6.3 Environmental management plan

The environmental and social management plan (ESMP) is a synthesis of all the impacts and proposed mitigation and assigns responsibility for the implementation of mitigation measures. It describes the range of environmental issues associated with the Project and outlines corresponding management strategies that will be employed to mitigate potential adverse environmental impacts.

The management plan during construction and operation is presented in Table 6.1.

6.3.1 Responsibility for implementation of ESMP

The responsibility for incorporation of mitigation measures into the contract documents lies with the Design Engineer. The Supervising Engineer's role is to ensure that the Contractor implements all specified mitigation measures.

The ESMP prepared in this report is a working document, which provides direction and assistance in:

- Construction activity planning and procedures to protect the environment;
- Environmental mitigation measures;
- Environmental emergency response measures.

The Supervising Engineer may periodically revise the ESMP in consultation with the Contractor, and subject to the approval from Ministry of Roads, Public Works and Housing (MoRPFW&H) and other review agencies such as NEMA and the local administration.
The MoRPW&H's Maintenance Unit will have to oversee the Supervising Engineer to confirm that mitigation measures are being implemented as specified. During the defects liability period (1 - 2 years after construction), the Contractor must make sure that the road is completely serviceable and ensure optimal performance of all structures.

After the defects liability period, responsibility for maintenance of the project road lies with the MoRPW&H's Maintenance Unit.

6.3.2 Responsibility for monitoring

The MoRPW&H has set up an Environmental and Social Unit (ESU) under its Planning Department. The ESU is best placed to ensure that monitoring does take place. The role, responsibility and capacity of the ESU is described in Sections 7.4 and 7.5.
### Table 6.1 Environmental and Social Monitoring and Management Plan

<table>
<thead>
<tr>
<th>Environmental/Social Impact</th>
<th>Proposed Mitigation and Aspects for Monitoring</th>
<th>Responsibility for intervention and monitoring during design and construction and first year of operation</th>
<th>Responsibility for mitigation, monitoring after the first year of operation</th>
<th>Monitoring means</th>
<th>Frequency of monitoring</th>
</tr>
</thead>
</table>
| Construction Camp           | - Sufficient measures should be taken at the construction camps i.e., provision of garbage bins and sanitation facilities. If septic tanks are installed, waste must be cleared periodically.  
- Special attention should be paid to the sanitary condition of camps.  
- Garbage should be disposed of periodically. | Contractor, Supervising Engineer. | | Site visit and visual inspection (c) | Daily (c) |
| Air pollution               | - Control speed of construction vehicles.  
- Prohibit idling of vehicles.  
- Residences should be 500m downwind of asphalt mixing sites.  
- Water should be sprayed during the construction phase on excavated areas for the dual carriageway, diversion routes, and temporary roads leading to borrow pits, and asphalt mixing sites.  
- In filling sub-grade water spraying is needed to solidify the material and to assist in compaction.  
- Plant trees along road and around settlements.  
- Regular maintenance of asphalt plant and construction equipment according to manufacturers specifications.  
- Impose speed limits for all vehicles, especially at trade centres and busy junctions. | Design Engineer, Contractor, Supervising Engineer. | | Visual inspection (c) | Daily (c) |

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<table>
<thead>
<tr>
<th>Environmental/ Social Impact</th>
<th>Proposed Mitigation and Aspects for Monitoring</th>
<th>Responsibility for intervention and monitoring during design and construction and first year of operation</th>
<th>Responsibility for mitigation, monitoring after the first year of operation</th>
<th>Monitoring means (c) = Construction (o) = Operation</th>
<th>Frequency of monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Maintain asphalt plant and construction equipment according to manufacturers' specifications.</td>
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<td></td>
<td>- Workers in the vicinity of high level noise to wear safety &amp; protective gear.</td>
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<td></td>
<td>- Impose speed limits for all vehicles, especially at market centres and busy junctions.</td>
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<tr>
<td>Oil pollution</td>
<td>- Construct parking bays at Salgaa and Mau Summit for heavy vehicles. Include oil interceptors in drains.</td>
<td>Design Engineer, Supervising Engineer, Contractor.</td>
<td>District Roads Engineer.</td>
<td>Visual inspection (c).</td>
<td>Daily (c).</td>
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<tr>
<td></td>
<td>- Ensure proper storage, handling and disposal of oil and oil wastes.</td>
<td>Supervising Engineer, Contractor.</td>
<td>Routine maintenance (o).</td>
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<tr>
<td></td>
<td>- Maintain asphalt plant and construction equipment according to manufacturers' specifications.</td>
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<td></td>
<td>- Maintenance of construction vehicles should be carried out in the Contractor's camp.</td>
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<tr>
<td>Public health and occupational safety</td>
<td>- Sensitisation campaign on STDs in the communities along the project road.</td>
<td>Contractor, Supervising Engineer.</td>
<td>District Public Health Officer, Environmental Unit (MORPW&amp;H).</td>
<td>District health records and Visual observation (c,o).</td>
<td>Twice a year.</td>
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<td></td>
<td>- Monitor solid and liquid waste disposal and collection facilities.</td>
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<tr>
<td>Environmental/Social Impact</td>
<td>Proposed Mitigation and Aspects for Monitoring</td>
<td>Responsibility for intervention and monitoring during design and construction and first year of operation</td>
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<td>Monitoring means (c) = Construction (o) = Operation</td>
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<tr>
<td>Material sites</td>
<td>- Inform people living at/near the sites that the pits have been selected for exploitation.</td>
<td>Supervising Engineer, Contractor.</td>
<td>Public meeting (c).</td>
<td>Once after site selection (c).</td>
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<td></td>
<td>- Arable lands should not be used as borrow pits whenever possible. For new borrow pits the topsoil (30cm) should be put aside and used for reinstatement after construction is over to minimise the impact on ecosystem and agriculture.</td>
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<td></td>
<td>- Prior to blasting, a thorough inspection of the rock stability should be conducted and all nearby residents given ample warning.</td>
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<td></td>
<td>- Plan access to gravel sites.</td>
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<td></td>
<td>- Control and restrict access to gravel sites (e.g. by fencing).</td>
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<td></td>
<td>- Control earthworks.</td>
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<td></td>
<td>- Proper management of excavation activities.</td>
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<td></td>
<td>- Landscape, terrace and if necessary grass sites. Replace trees that were removed during excavation.</td>
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<td></td>
<td>- Install drainage structures properly.</td>
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<td></td>
<td>- Install erosion control measures.</td>
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<td></td>
<td>- Landscape embankments and re-vegetate gravel sites with grass and indigenous shrubs.</td>
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<table>
<thead>
<tr>
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<th>Responsibility for intervention and monitoring during design and construction and first year of operation</th>
<th>Responsibility for mitigation, monitoring after the first year of operation</th>
<th>Monitoring means (c) = Construction (o) = Operation</th>
<th>Frequency of monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversion routes</td>
<td>- Ensure management of excavation activities.</td>
<td>Supervising Engineer. Maintenance Unit (MoRPW&amp;H).</td>
<td>Visual inspection (c,o). Daily when deviations are in use (c). Twice a year to monitor reinstatement (o).</td>
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<td></td>
<td>- Plan diversion routes.</td>
<td>Supervising Engineer, Contractor.</td>
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<td></td>
<td>- Adhere to road reserve if possible.</td>
<td>Maintenance Unit (MoRPW&amp;H).</td>
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<td></td>
<td>- Obtain permission from inhabitants if diversion routes go beyond the Right of Way.</td>
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<td></td>
<td>- Reinstate diversion routes (and old tracks) to original condition.</td>
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<td></td>
<td>- Management of traffic along diversion routes.</td>
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<tr>
<td>Road Safety</td>
<td>- Install warning signs on approach to trade centres and busy junctions.</td>
<td>Supervising Engineer, Contractor. Design Engineer, Supervising Engineer, Contractor.</td>
<td>District Roads Engineer, Maintenance Unit (MoRPW&amp;H).</td>
<td>Visual inspection (c). Routine maintenance (o). During installation (c). Once a year (o).</td>
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<tr>
<td></td>
<td>- Provide parking bays for heavy goods vehicles and public transport vehicles.</td>
<td>Design Engineer, Supervising Engineer, Contractor.</td>
<td>District Roads Engineer, Maintenance Unit (MoRPW&amp;H).</td>
<td>Visual inspection (c). Routine maintenance (o). During installation (c). Once a year (o).</td>
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<td></td>
<td>- Provide separate footpaths and cycle lanes.</td>
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<td>- Install guard-rail, marker posts bollards.</td>
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<td>- Install street lighting systems.</td>
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<td></td>
<td>- Enforce speed limits.</td>
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<tr>
<td>Roadside drainage</td>
<td>- Install drainage structures correctly.</td>
<td>Design Engineer, Supervising Engineer, Contractor.</td>
<td>District Roads Engineer, Maintenance Unit (MoRPW&amp;H).</td>
<td>Visual inspection (c). Routine maintenance and road condition survey (o). During installation (c). Once a year (o).</td>
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<td></td>
<td>- Damaged existing drainage systems should be rebuilt or rehabilitated by suitable methods.</td>
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<td>- Grouted stone pitching and rock fill gabion works will be necessary to protect culvert inlets and outlets.</td>
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<tr>
<td>Environmental/ Social Impact</td>
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<tr>
<td>Vegetation</td>
<td>- Control clearing of crops.</td>
<td>Contractor, Supervising Engineer.</td>
<td>Maintenance Unit (MoRPW&amp;H).</td>
<td>Visual inspection (c,o.)</td>
<td>Random (c,o).</td>
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<td>- Avoid clearing using herbicides.</td>
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<td>- Replant areas where vegetation is unnecessarily removed.</td>
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<td>- Plant trees along the road at approaches to main trading centres such as Salgaa, Mau Summit, Timboroa.</td>
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<td></td>
<td>- Landscaping and planting all disturbed areas (pits, deviations, embankments, camp sites).</td>
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<td>- Plant grass along the median of the dual carriageway.</td>
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<td>- Care for trees/plants.</td>
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<tr>
<td></td>
<td>- Plan works schedule according to water availability.</td>
<td>Contractor, Supervising Engineer.</td>
<td>Maintenance Unit (MoRPW&amp;H).</td>
<td>Inspection of plans &amp; records (c).</td>
<td>Random.</td>
</tr>
<tr>
<td></td>
<td>- Energy sources should be identified so as not to put a strain on the local resources.</td>
<td>Contractor.</td>
<td>Maintenance Unit (MoRPW&amp;H).</td>
<td>Inspection (c).</td>
<td>Daily (c).</td>
</tr>
<tr>
<td></td>
<td>- Discourage use of firewood/charcoal by providing alternatives such as kerosene and gas.</td>
<td>Contractor.</td>
<td>Maintenance Unit (MoRPW&amp;H).</td>
<td>Inspection (c).</td>
<td>Daily (c).</td>
</tr>
<tr>
<td></td>
<td>- Provide and erect a 1.5m high chain-link fence upheld with 2m cemented and treated wooden posts at 2m intervals along the project road.</td>
<td>Design Engineer, Contractor, Supervising Engineer.</td>
<td>District Roads Engineer, Environmental Unit (MORPW&amp;H).</td>
<td>Visual inspection (c).</td>
<td>During installation (c) Quarterly (o).</td>
</tr>
</tbody>
</table>
6.4 Costs of mitigation

Construction related costs for mitigation of environmental impacts have been included in the Bill of Quantities (BoQ) for the design of the project road. Table 6.2 presents the environmental mitigation measures included in the BOQ.

A mitigative measure against encroachment into the road reserve, fencing or demarcation of the extent of the road reserve has also been included.

**Table 6.2 Environmental mitigation measures that have been included in the BOQ**

<table>
<thead>
<tr>
<th>Environmental/Social Impact</th>
<th>Proposed Mitigation and Aspects for Monitoring</th>
<th>Mitigation and Monitoring Costs (Kshs)</th>
<th>Costs of Mitigation already included in BoQ (Kshs)</th>
</tr>
</thead>
</table>
| Construction Camp           | - Sufficient measures should be taken at the construction camps i.e., provision of garbage bins and sanitation facilities. If septic tanks are installed, waste will be cleared periodically.  
- Special attention should be paid to the sanitary condition of camps.  
- Garbage should be disposed of periodically. |                                     | Distributed in contract rates and price. |
| Air pollution               | - Control speed of construction vehicles.  
- Prohibit idling of vehicles.  
- Residences should be 500m downwind of asphalt mixing sites.  
- Water should be sprayed during the construction phase on excavated areas for the dual carriageway, diversion routes, and temporary roads leading to borrow pits, and asphalt mixing sites.  
- In filling sub-grade water spraying is needed to solidify the material and to assist in compaction.  
- Plant trees along road and around settlements.  
- Regular maintenance of asphalt /crushing plant and construction equipment according to manufacturers' specifications.  
- Impose speed limits for all vehicles, especially at trade centres and busy junctions. | Bill 9, Item 9.02.  
Contractor's planning and administration costs.  
Bill 9, Item 9.03, 9.04.  
Bill 5, 5.01 - 5.06.  
Bill 20, Item 20.18.  
Distributed in contract rates and price.  
Bill 20, 20.17. | |
| Noise pollution             | - Supervise construction traffic.  
- Maintain asphalt /crushing plant and construction equipment according to manufacturers' specifications.  
- Workers in the vicinity of high level noise to wear safety & protective gear.  
- Impose speed limits for all vehicles, especially at market centres and busy junctions. | Contractor's planning and administration costs.  
<table>
<thead>
<tr>
<th>Environmental/ Social Impact</th>
<th>Proposed Mitigation and Aspects for Monitoring</th>
<th>Mitigation and Monitoring Costs (Kshs)</th>
<th>Costs of Mitigation already included in BoQ (Kshs)</th>
</tr>
</thead>
</table>
| Oil pollution               | - Construct parking bays at Salgaa and Mau Summit for heavy vehicles. Include oil interceptors in drains.  
- Ensure proper storage, handling and disposal of oil and oil wastes.  
- Maintain asphalt plant and construction equipment according to manufacturers' specifications. | 0.25% of Bills 5,12-16,20, and 23. To be included in the BoQ Bill 8, Item 8.21, interceptors, to be included in the BoQ. | Provision of waste oil drums and disposal in designated areas.  
Distributed in contract rates and price. |
| Public health and occupational safety | - Sensitisation campaign on STDs in the communities along the project road.  
- Monitor solid and liquid waste disposal and collection facilities. | Distributed in contract rates and price,(see special specs Clause 117). | |
| Material sites              | - Inform people living at/near the sites that the pits have been selected for exploitation.  
- Arable lands should not be used as borrow pits whenever possible. For new borrow pits the topsoil (30cm) should be put aside and used for reinstatement after construction is over to minimise the impact on ecosystem and agriculture.  
- Prior to blasting, a thorough inspection of the rock stability should be conducted and all nearby residents given ample warning.  
- Plan access to gravel sites.  
- Control and restrict access to gravel sites (e.g. by fencing).  
- Control earthworks.  
- Proper management of excavation activities.  
- Landscape, terrace and if necessary grass sites. Replace trees that were removed during excavation. | Ministry of Lands and Settlement.  
Covers reinstatement of borrow pits.  
Distributed in contract rates and price. | Specialist to carry out a stability analysis.  
Bill 9, Item 9.04.  
80% of Bill 20, Item 20.02.  
Contractor’s planning and administration costs.  
Bill 5, Items 5.07 - 5.09. |
| Soil erosion                | - Control earthworks.  
- Install drainage structures properly.  
- Install erosion control measures.  
- Landscape embankments and re-vegetate gravel sites with grass and indigenous shrubs.  
- Ensure management of excavation activities. | Bill 7, Item 7.08-7.10.  
Bill 8, Items 8.19, 8.21.  
Bill 8, Items 8.19, 8.21.  
Bill 5, Items 5.08, 5.09. | |
| Diversion routes            | - Plan diversion routes.  
- Adhere to road reserve if possible.  
- Obtain permission from inhabitants if diversion route goes beyond the Right of Way. | Distributed in contract rates and price. | |
<table>
<thead>
<tr>
<th>Environmental/ Social Impact</th>
<th>Proposed Mitigation and Aspects for Monitoring</th>
<th>Mitigation and Monitoring Costs (Kshs)</th>
<th>Costs of Mitigation already included in BoQ (Kshs)</th>
</tr>
</thead>
</table>
|                              | - Reinstate diversion routes (and old tracks) to original condition.  
|                              | - Management of traffic along diversion. | Bill 9, Item 9.01. |  
|                              | - Install warning signs on approach to trade centres and busy junctions.  
| Road Safety                  | - Provide parking bays for heavy goods vehicles and public transport vehicles.  
|                              | - Provide separate footpaths and cycle lanes.  
|                              | - Install guard-rail, marker posts bollards.  
|                              | - Install street lighting systems.  
| Roadside drainage            | - Install drainage structures correctly.  
|                              | - Damaged existing drainage systems should be rebuilt or rehabilitated by suitable methods.  
|                              | - Grouted stone pitching and rock fill gabion works will be necessary to protect culvert inlets and outlets. | Bill 8, Item 8.05, 8.09, 8.22, 8.23.  
|                              | - Damaged existing drainage systems should be rebuilt or rehabilitated by suitable methods.  
|                              | - Damaged existing drainage systems should be rebuilt or rehabilitated by suitable methods.  
|                              | - Damaged existing drainage systems should be rebuilt or rehabilitated by suitable methods.  
| Vegetation                   | - Control clearing of crops.  
|                              | - Avoid clearing using herbicides.  
|                              | - Replant areas where vegetation is unnecessarily removed.  
|                              | - Plant trees along the road at approaches to main trading centres such as Salgaa, Mau Summit, Timboroa.  
|                              | - Landscaping and planting all disturbed areas (pits, deviations, embankments, camp sites).  
|                              | - Plant grass along the median of the dual carriageway. | Contractor's planning and administration costs. |  
| Water Sources                | - Management of water usage.  
|                              | - Plan for harvesting and storage of water during rains for use during construction.  
|                              | - Plan works schedule according to water availability. | Contractor's planning and administration costs. |  
| Fuel                         | - Energy sources should be identified so as not to put a strain on the local resources.  
<p>|                              | - Discourage use of firewood charcoal by providing alternatives such as kerosene and gas. | Distributed in contract rates and price. |<br />
| Encroachment into road reserve | - Provide and erect a 1.5 m high chain-link fence upheld with 2 m cemented and treated wooden posts at 2 m intervals along the project road. | 3,892,000@ Kshs 40,000 per Km. | Not included in BoQ. |</p>
<table>
<thead>
<tr>
<th>Environmental/ Social Impact</th>
<th>Proposed Mitigation and Aspects for Monitoring</th>
<th>Mitigation and Monitoring Costs (Kshs)</th>
<th>Costs of Mitigation already included in BoQ (Kshs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pollution Noise Pollution Oil Pollution Solid waste management.</td>
<td>- Sensitisation and Awareness Campaign to construction workers and communities.</td>
<td>Included in monitoring costs.</td>
<td>To be conducted during construction and every five years during the project lifetime.</td>
</tr>
<tr>
<td>Capacity and Awareness Building.</td>
<td>- Training and awareness for the effective implementation of the Environmental Management Plan.</td>
<td>Included in training costs.</td>
<td>To be conducted during construction and maintenance of the road.</td>
</tr>
<tr>
<td>Off road environmental activities.</td>
<td>- Mitigation of off-road environmental activities during construction.</td>
<td></td>
<td>This sum is 0.5% of the total project cost to be used as directed by the Engineer.</td>
</tr>
<tr>
<td>Contractors overheads and profits.</td>
<td>-</td>
<td></td>
<td>This sum is 15% of the off road environmental activities cost. This sum will cover the Contractor's overheads and profits.</td>
</tr>
</tbody>
</table>
7 ENVIRONMENTAL AND SOCIAL MONITORING

Appropriate environmental monitoring indicators should be selected for both the re-
construction and the road operation phases. It is envisaged that monitoring be undertaken by
the Environmental and Social Unit of the Ministry of Roads, Public Works and Housing.

The preceding sections outline the indicators for monitoring during construction and operation
phases of the project road. The associated cost estimates for monitoring have also been
included. In addition, the institutional responsibilities and capacity for monitoring and the
training needs have been discussed.

7.1 Indicators for monitoring during the construction phase

The recommended indicators for monitoring during the construction phase include:

- A simple questionnaire to assess the awareness level of the Contractor's team on public
  health issues, such as HIV/AIDS and environmental issues (air, water and land pollution).
  This could take the form of double checking whether they were provided with awareness
  training at the start of the Project as recommended in the mitigation measures. For
  environmental issues, simple questions could include 'what do you do with your waste
  products?'
- The effectiveness of rehabilitation of quarries and borrow pits by the Contractor – the
  Supervising Engineer / Environmental Officer to locate the borrow pits one year after the
  last contract payment of the Contractor or have the re-vegetation programmes improve
  the area in comparison to its original condition;
- The effectiveness of rehabilitation of construction camps, as above.
- The efficiency of drainage structures;
- Compensation of Project Affected People;
- An assessment of the amount of timber used for the Project. This should include
  quantification, the source and comments on proof of sustainability.
- An estimate on the saving in material needs by recycling the bitumen.
- Noise, vibration and air emissions surveys of selected pieces of equipment used during
  construction.

7.2 Indicators for monitoring during road operation

The recommended indicators for monitoring during the operation phase include:

- An assessment of the number and placement of HIV/AIDS awareness signs and
  community perceptions;
- Effectiveness of the HIV/AIDS awareness campaigns;
- Vehicle emissions, ambient air quality and noise surveys at selected locations along the
  project road;
- A measurement of the increase/reduction in plastic and other waste over a section of road
  over a given time period and whether or not a fining system has been implemented;
- An assessment on whether the roadside charcoal, timber and woodfuel sales have been
  legitimised, since Project inception;
- An assessment on the length, width and number of separate cycle/pedestrian ways;
7.3 Costs for monitoring

Monthly rates are provided for monitoring environmental impacts and mitigation during the construction phase. During the operation phase, it is envisaged that monitoring will be financed for the first five years by the project. After this, costs for monitoring could be financed from Fuel Levy funds or other sources of financing that the Ministry of Roads (MoRPW&H) allocates. Monitoring costs are presented in Table 7.1.

Table 7.1 Costs for monitoring environmental impacts

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cost of monitoring (USD)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progress of rehabilitated gravel sites, construction camp yards etc.</td>
<td>100 per month.</td>
<td>RAP. Environmental and Social Unit of the MoRPW&amp;H to monitor. Costs would cover fuel and a driver.</td>
</tr>
<tr>
<td>Efficiency of drainage structures.</td>
<td></td>
<td>Part of the annual Maintenance Needs Assessment involving a road condition survey carried out by the District Engineer. The assessment should include an environmental officer from the MoRPW&amp;H.</td>
</tr>
<tr>
<td>Impact of erosion (on road, off road, embankments, riverbanks, etc.).</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Efficiency of erosion control measures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pay compensation for crops/property removed/destroyed by deviations on inhabited land.</td>
<td></td>
<td>RAP. Ministry of Lands and Settlement pays out to the Project Affected People.</td>
</tr>
<tr>
<td>Monitor rehabilitation of diversion routes.</td>
<td>300 per month.</td>
<td>Part of the annual Maintenance Needs Assessment.</td>
</tr>
<tr>
<td>Monitor road accidents.</td>
<td>300 per month.</td>
<td>Traffic police.</td>
</tr>
<tr>
<td>Social conditions of project affected people (PAP).</td>
<td></td>
<td>RAP.</td>
</tr>
<tr>
<td>Compensation payments to PAP.</td>
<td></td>
<td>RAP.</td>
</tr>
<tr>
<td>Monitoring solid waste disposal and collection facilities.</td>
<td>100 per month.</td>
<td>During construction by observation and provision of garbage bins and transport to a designated area.</td>
</tr>
<tr>
<td>Monitor waste water management.</td>
<td>100 per month.</td>
<td>During construction by observation and provision of proper effluent channels.</td>
</tr>
<tr>
<td>Care for trees/plants.</td>
<td>200 per month.</td>
<td>Responsibility of Local Councils. Costs would cover fuel and a driver.</td>
</tr>
<tr>
<td>HIV/AIDS Awareness campaign.</td>
<td>USD 50,000 over 5 years.</td>
<td>MoRPW&amp;H, Ministry of Tourism and Information and Ministry of Health.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Cost of monitoring (USD)</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Air pollution (SO₂, NOₓ, SPM, lead).</td>
<td>USD 20,000 Every 5 years for the project lifetime.</td>
<td>These studies would require the services of a consultant.</td>
</tr>
<tr>
<td>Noise pollution.</td>
<td>USD 10,000 Every 5 years for the project lifetime.</td>
<td>The Environmental and Social Unit of the MoRPW&amp;H would need to keep a database of all the information collected and use it as a reference for future studies.</td>
</tr>
<tr>
<td>Water quality (physical, chemical and bacteriological analysis).</td>
<td>USD 10,000 Every 5 years for the project lifetime.</td>
<td></td>
</tr>
<tr>
<td>Socio-economic impact studies.</td>
<td>USD 10,000 per year Twice a year for the first year then every 5 years for the project lifetime.</td>
<td></td>
</tr>
</tbody>
</table>

* The Resettlement Action Plan (RAP) is a stand-alone report and details who should be compensated and makes recommendations on who should compensate and monitoring of the PAPs.

### 7.4 Institutional responsibilities for monitoring

#### 7.4.1 Ministry of Roads Public Works and Housing

The MoRPW&H has established an Environmental and Social Unit (ESU) in the Roads Department whose objectives are as follows:

- To achieve a comprehensive policy in terms of environmental management;
- To integrate environmental and social concerns into road works activities;
- To create awareness within the Roads Department as to the importance of environmental management in road construction, rehabilitation, improvement and maintenance activities;
- To strengthen the capacity within the MoRPW&H to be able to handle environmental and social issues pertaining to the road sub-sector;
- To form a focal point for co-ordination for both government and non-governmental organisation for all environmental and social matters concerning roads.

#### 7.4.2 Role of the Environmental and Social Unit

The role of the ESU will be to:

- Develop environmental road sub-sector standards and guidelines.
- Ensure compliance with Environmental Management and Co-ordination Act of 1999, and Environmental Impacts Assessment and Audit Regulation of 2003 as they relates to the road sub-sector.
- Review and update road department documents e.g. Standard Specification and contract Documents.
- Participate in inspection for certification of substantial completion carried out by the roads department.
- Screen proposed road rehabilitation project to determine Environmental Impact Assessment Category.
- Review environmental and social management plans that have been prepared.
- Set up a system for continuous monitoring and periodic surveillance.
- Audit road rehabilitation, improvement and maintenance activities.
- Works with and obtain feedback from the District and Provincial Engineers on all roads.
- Liaise with Government, parastatals and non-governmental organisations, including NEMA, concerned with environmental issues with a view to addressing common priorities.
- Create awareness and sensitize the public with regard to proposed road projects, their potential impacts and the need for planning in the event that people are going to be affected.
- Ensure compliance of the road sub-sector EIAs to public consultation and disclose procedures as required by the Environmental Management and Co-ordination Act and World Bank environment and social safeguard policies.
- Set up a computerised environment and socio-economic database relevant to road work activities.

Currently there is only one (1) environmentalist working at the ESU. In order to strengthen the ESU the recommended staffing could include:

- Senior Environmentalist – Head of Unit.
- 2 Environmentalists – Assistants.
- 1 Sociologist.
- 1 Information Technologist.
- 1 Engineer.
- 2 drivers.
- 2 secretaries.
- 1 messenger.

Given the amount of work that the Unit will have to undertake as it gets established, and the monitoring of roads projects countrywide, there may be a need to increase its capacity to take on more staff.

**7.5 Training and capacity building**

For the effective implementation of the Environmental Management Plan of the project there is an urgent need for training, capacity and awareness building. The Environmental and Social Unit in the MoRPW&H will ensure that the training, capacity and awareness building is undertaken, and that mitigation measures and monitoring concerns for the project road are implemented.

**7.5.1 Target groups**

Training is required at all levels to effectively implement the Environmental Management Plan. The target groups identified for this project can be divided into three groups:

**Group A** Road Workers:

This group consists of Engineers (Resident, Provincial, Project,) Contractors, Supervisors, Site Agents, Site Managers and the Environmental and Social Unit in the MoRPW&H. These are the top management staff concerned with road construction, monitoring of impacts and maintenance.

**Group B** Road Users: Transport Associations

Examples include the Truck Drivers Association, and Matatu Drivers Association. For this group of people the road is their source of livelihood.

**Group C** Project Affected People (PAP):

These comprise business people including farmers. These people have businesses (e.g. kiosks, offices, schools, etc.) that can potentially be affected by the road, or they live by the roadside.
Table 7.2 presents a breakdown of the target groups for training necessary to implement the environmental management plan during construction and operation of the project road. The cost estimate and duration for undertaking the training is presented in Table 7.3.

### Table 7.2. Breakdown of the target groups for training during the construction phase

<table>
<thead>
<tr>
<th>Target group</th>
<th>Category</th>
<th>Number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supervision</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>Engineers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Provincial Engineer</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Project Engineer</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Resident Engineer</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Assistant Engineers</td>
<td>6</td>
</tr>
<tr>
<td>Group B</td>
<td>Surveyor</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Inspector of Works</td>
<td>8</td>
</tr>
<tr>
<td>Group C</td>
<td>Casuals/unskilled labour</td>
<td>30</td>
</tr>
</tbody>
</table>

Sub Total 52

<table>
<thead>
<tr>
<th>Target group</th>
<th>Category</th>
<th>Number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contractor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>Site Engineer</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Site Agent</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Site Manager</td>
<td>6</td>
</tr>
<tr>
<td>Group B</td>
<td>Foremen</td>
<td>16</td>
</tr>
<tr>
<td>Group C</td>
<td>Labourers</td>
<td>400</td>
</tr>
</tbody>
</table>

Sub Total 426

### Table 7.3. Cost estimate and duration for training

<table>
<thead>
<tr>
<th>Target Group</th>
<th>Cost per day (Kshs)</th>
<th>Days</th>
<th>Number of participants</th>
<th>Cost per target group (Kshs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>7,500</td>
<td>3</td>
<td>22</td>
<td>495,000</td>
</tr>
<tr>
<td>Group B</td>
<td>5,500</td>
<td>3</td>
<td>26</td>
<td>429,000</td>
</tr>
<tr>
<td>Group C</td>
<td>2,000</td>
<td>2</td>
<td>430</td>
<td>1,720,000</td>
</tr>
</tbody>
</table>

Total 2,644,000

#### 7.5.2 Training requirements

Training can be based on modules aimed at:
a. Developing awareness of the need to consider environmental issues during construction, operation and maintenance of roads;

b. Creating awareness and understanding of the environmental legal framework pertaining to roads;

c. Developing skills for
   i) Identification and assessment of environmental impacts of road projects
   ii) Incorporation of mitigation measures at all stages of road development
   iii) Reviewing EIA reports and incorporating measures into the decision making process

Table 7.4 presents the recommended topic modules and costs the three target groups necessary to implement the Environmental Management Plan.
Table 7.4 Recommended topic modules and costs for each of the target groups

<table>
<thead>
<tr>
<th>Topic modules</th>
<th>Target Group</th>
<th>No. of participants</th>
<th>No. of days</th>
<th>Cost per unit (Kshs)</th>
<th>Cost in (Kshs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understanding of EIA legislation in Kenya.</td>
<td>Group A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Develop awareness of the environmental implications of roads and procedures for assessment.</td>
<td>Road Workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Develop awareness and understanding of the human resource and institutional arrangements for managing environmental impact studies.</td>
<td></td>
<td>22</td>
<td>33</td>
<td>7,500</td>
<td>495,000</td>
</tr>
<tr>
<td>4. Develop an understanding of how policy can be developed and incorporated into environmental management.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Importance of incorporating mitigation measures during road planning and design and implementing an environmental monitoring programme.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Impart skills on environmental auditing and monitoring during road construction and maintenance.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. General understanding of EIA legislation in Kenya.</td>
<td>Group B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Sensitisation on health (STDs including HIV/AIDS), littering, solid and liquid waste management.</td>
<td>Road Users</td>
<td>26</td>
<td>3</td>
<td>5,500</td>
<td>429,000</td>
</tr>
<tr>
<td>2. Sensitisation on health (STDs including HIV/AIDS), littering, solid and liquid waste management.</td>
<td>PAP</td>
<td>430</td>
<td>2</td>
<td>2,000</td>
<td>1,720,000</td>
</tr>
<tr>
<td>3. Implications of encroachment onto the road reserve.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,644,000</td>
</tr>
<tr>
<td>15% contingency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>396,600</td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3,040,600</td>
</tr>
</tbody>
</table>
The findings of the environmental impact assessment (EIA) conclude that the impact of rehabilitating the Lanet – Nakuru – Timbora road is positive overall on the socio-economic environment of the area. However, the impact of the project on the bio-physical environment is potentially slightly to moderately negative both in the construction phase and over the life of the road, if appropriate mitigation and support measures are not employed.

The mitigative and support measures proposed are generally straightforward. The majority of the measures relate directly to sound operating practices both during the construction phase and subsequently over the operational life of the road.

The costs for mitigation of construction related impacts have been included in the contract documents. Other costs that will need to be included prior to project start up include:

- Fencing to deter encroachment onto the road reserve (KShs 3,892,000): US$512,000.
- Monthly monitoring during the construction phase: US$ 1,100.
- Costs for monitoring impacts for five years during the operation phase: US$100,000.
- Costs for training and capacity building (KShs 3,040,600): approx. US$ 40,000.

Provided the road is rehabilitated with due attention to the mitigation and support measures outlined, the project is likely to have a positive impact on both the bio-physical and socio-economic environment of the area. It is recommended that this road rehabilitation project be implemented and that the proposed mitigation and monitoring measures are enforced.
Photo 1: Charcoal for sale at Ksh 250 per sack not far from Mau Summit.

Photo 2: A potential borrow pit site, MS2 along the Lanet - Nakuru - Timboroa road
Photo 3: Asphalt and Dense Bitumen Macadam (DBM) drums directly on soil

Photo 4: Salgaa Market along the Lanet – Nakuru – Timboroa road
Photo 5: Plastic and other litter adjacent to a culvert along the Lanet – Nakuru – Timboroa road
### DOCUMENT CONTROL SHEET

**PROJECT:** Northern Corridor Road Improvement Project  
**JOB NO:** JK1185  
**TITLE:** Draft Environmental Impact Assessment of Lanet - Mau Summit - Timboroa

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<td><strong>Sean Avery</strong></td>
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</thead>
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<td><strong>NAME</strong></td>
<td><strong>NAME</strong></td>
</tr>
<tr>
<td><strong>DATE</strong></td>
<td><strong>SIGNATURE</strong></td>
<td><strong>SIGNATURE</strong></td>
</tr>
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