ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED HIGH GRAND FALLS MULTI-PURPOSE DAM PROJECT

ESIA STUDY REPORT

Prepared by:

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Environmental and Social Impact Assessment Study Report for the Proposed High Grand Falls Multi-Purpose Dam Project

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Disclaimer:
This Environmental Impact Assessment Study Report is strictly confidential to TARDA (the Proponent) and any use of the materials thereof should be strictly in accordance with the agreement between the Proponent and KenfaceEnconsult Limited (the consultant). It is, however, subject to conditions in section 34 of the Environmental (Impact Assessment and Audit) Regulation 2003.
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ACKNOWLEDGEMENT

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We extend our sincere thanks to the Managing Director and the Project Coordinators, Eng. Henry Maina and Samuel Gitonga for their invaluable support in ensuring the success of this ESIA study.

We appreciate the co-operation and contributions of the County and sub-County staff, local administration and communities in the project area who made their contributions during the stakeholders consultations and participation in the process. The vital information on this Environment and Social Impact Assessment could not have been obtained without the cooperation and support of all the stakeholders consulted.

To all persons that contributed in one way or another to ensure the success of this ESIA and have not been mentioned, kindly receive our appreciation.

- KenfaceEnconsults (Africa) Ltd
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<tr>
<td>CBO</td>
<td>Community Based Organisation</td>
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<td>CC</td>
<td>County Commissioner</td>
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<tr>
<td>CIDP</td>
<td>County Integrated Development Plan</td>
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<tr>
<td>CMS</td>
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<td>ITCZ</td>
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<td>KenGen</td>
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<td>Km</td>
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<td>Km²</td>
<td>Square Kilometres</td>
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<tr>
<td>KPLC</td>
<td>Kenya Power and Lighting Company</td>
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<td>Masl</td>
<td>Metres above sea level</td>
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<td>mm</td>
<td>millimeters</td>
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<tr>
<td>MoRDA</td>
<td>Ministry of Regional Development Authorities</td>
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<tr>
<td>NEAP</td>
<td>National Environmental Action Plan</td>
<td></td>
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<tr>
<td>NEMA</td>
<td>National Environment Management Authority</td>
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</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
<td></td>
</tr>
<tr>
<td>RFC</td>
<td>Rock Filled Concrete</td>
<td></td>
</tr>
<tr>
<td>SCC</td>
<td>Self-Compacting Concrete</td>
<td></td>
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<td>TARDA</td>
<td>Tana and Athi River Development Authority</td>
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<td>TOL</td>
<td>Temporary Occupation Licenses</td>
<td></td>
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<td>WRMA</td>
<td>Water Resources Management Authority</td>
<td></td>
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<tr>
<td>WRUAs</td>
<td>Water Resource Users Associations</td>
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</table>
EXECUTIVE SUMMARY

Introduction
TARDA is proposing to develop a High Grand Falls Multi-Purpose Dam on river Tana. The project site is located 50 km downstream of the Kiambere Hydro Power Station along the River Tana in Tharaka-Nithi County. The main objective of the High Grand Falls Project is to provide a large-Scale Multi-Purpose Water Reservoir catering for Public water Supply, Irrigation, River Regulation, Flood Control and Power Generation in order to effectively contribute to the regional and national social-economic development.

The reservoir will provide large-scale water storage at the middle reach of the Tana River, thus making it possible to augment dry season flows for Lower Tana and allow increased draw off upstream.

The Kenya Government policy on all new projects requires that an Environmental Impact Assessment (EIA) study be carried out at the project planning stages to ensure that significant impacts on the environment are taken into consideration. Dams are some of the projects listed under the second schedule of the Environmental Management and Coordination Act (1999) that should undergo an ESIA.

KenfaceEncosult Limited has therefore been contracted by TARDA to conduct an ESIA for the proposed construction of the Dam to increase water storage levels, as per terms of reference that were developed for this study. The objective of this assignment is to ensure that the potentially adverse environmental and social impacts can be minimized and the positive impacts enhanced.

Justification of the need of the Dam
In its present state, Tana River is incapable of meeting any major future water demands unless this Project is implemented. The reasons are:

- The current Physical water unavailability in the dry seasons will preclude the planning of any new major irrigation developments either in the Upper or Lower Tana catchments unless there is increased Water storages and river regulation.
- Development of needed public water supplies especially for the coastal tourist towns will only be possible at the expense of reduced hydropower production, from the existing schemes in the absence of High Grand Falls.
- Further Hydroelectric Power development potential downstream of the High Grand Falls site is inhibited by the lack of security against drought conditions.
- Domestic and industrial water supply to Lamu for the LAPSSET and to Tana River County for the Galana irrigation Project.
- The 200,000 hectares of virgin land at the Tana Delta can only be developed after the High Grand Falls Dam is built.
- The Tana River tributaries originating from the eastern and some southern slopes of Mount Kenya are not regulated and are the main causes of the...
perennial flooding and destruction of the lower Tana counties. The High Grand Falls Dam is the only long-term option to control this situation.

- Proposed intra and inter basin Water transfers shall only be realized with the High Grand Falls Reservoir
- The development of Tana and Athi River Basins constitute major flagship projects in the Vision 2030.

ESIA Methodology
The study was carried out at desk level and also through a detailed and structured field study. The process included: collection of baseline data to describe the status of the project site before project implementation commences; data analysis and evaluation; public participation to identify the concerns of persons likely to be affected by the project; and preparation of an ESIA study report encompassing the details specified in the Environmental Impact Assessment/Audit Regulations (2003).

Policy, Legal and Regulatory Framework
The Environmental Management and Co-ordination Act 1999, is the legislation that governs ESIA studies in Kenya. This project falls under the Second Schedule of EMCA 1999, which lists the type of projects that are required to undergo ESIA studies. Other key national laws that govern the management of environmental resources in the country have been discussed in this report.

Project Main Project Components
- The Main Dam of length 2.5km and maximum height of 115m consisting of a Clay Core Rock fill Dam with a central roller compacted concrete dam occupying the river valley section and two smaller Saddle Dams.
- The reservoir will have a storage capacity of 5.7 billion cubic meters.
- The Spill way is designed for a discharge of 9,000 $m^3/s$ and is a gated structure with four Tainter gates of 18m length and 15m height. The flow is then guided to a flip bucket that makes a hydraulic jump. As per the international standards, the spillway will be able to safely handle the 1:10,000 years flood.
- Diversion structures consists of a diversion tunnel consisting of two tubes 10m diameter plus associated cofferdam.
- Intakes consist of the inlet section 7m in height and 8m width equipped with guard gates which can shut off the groups of the plant.
- Penstocks will be fabricated of steel. These will be 7 in number of unit length 120m, 4500mm diameter and gross head 106m.
- The Power Plant will be constructed at the dam toe with no need for tunnels and is of the open-air type made easy by the association with the concrete dam. It will be equipped with Francis type turbines of 100MW each. The power plant could in the future deliver 700MW of peaking capacity. It is proposed to install 500MW at first, and upgrade the capacity later to 700MW.
Transmission Lines: an 80km line with a voltage of 220KV to connect the grid at Kiambere Dam will be constructed.

Power Generation - The installed capacity of HGF will be an initial 500 MW with the Dam designed to allow for an increase of a further 200 MW at a later stage as the power is needed.

Project Cost
The HGF dam is estimated to cost US$1.755 billion including engineering services and contingencies.

Summary of Findings
A number of positive and negative anticipated impacts to the environmental and social wellbeing were identified. During the construction phase, they relate mainly to waste generation; soil erosion and sedimentation; loss of vegetation cover, the potential for hazardous materials to contaminate the environment; and occupational health and safety issues. In the operations phase, positive impacts such as availability of water for irrigation, tourism, increased business opportunities were identified as well as improved supply of electricity to the Country. Potentially negative impacts included increased human/wildlife conflict, loss of land, water quality degradation and a number of occupational health and safety issues.

Mitigation Measures
Although there is indisputable justification of the proposed Construction of the proposed HGF Dam, there are significant environmental and social issues associated with the construction and operation of the proposed project that are summarized as follows:

<table>
<thead>
<tr>
<th>Project Activities</th>
<th>Environmental and Social Issues</th>
<th>Management Action Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Preparation Activities</td>
<td>Social conflicts</td>
<td>✔ Notify and sensitize all affected land owners before surveying their land, ✔ Involve the local administration and other social groups in social moderations</td>
</tr>
<tr>
<td>Preliminary Construction Activities</td>
<td>Acquisition process of required land for the project construction and buffer zone as well as camp sites</td>
<td>✔ Undertake a comprehensive land acquisition and resettlement action plan (LAP &amp; RAP) as a basis for compensations, ✔ Compensate appropriately any land acquired for the main dam, evacuation power line corridor, access roads and the power house, buffer zones, water treatment plant, sand traps, the pipelines and storage tanks, ✔ Sensitize landowners on necessary land use changes for the protection of the dam.</td>
</tr>
<tr>
<td>Preliminary Construction</td>
<td>Potential social conflicts</td>
<td>✔ Collaborate with the local leadership to avert social conflict</td>
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<tr>
<td>Project Activities</td>
<td>Environmental and Social Issues</td>
<td>Management Action Plans</td>
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<td>------------------------------------</td>
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<td>------------------------------------------------------------------------------------------</td>
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<tr>
<td><strong>Activities</strong></td>
<td></td>
<td></td>
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<tr>
<td>− Dam Catchment delineation</td>
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<tr>
<td><strong>Site clearing</strong></td>
<td></td>
<td>✓ Confine vegetation removal to the surveyed necessary project area only,</td>
</tr>
<tr>
<td>− Vegetation removal</td>
<td>- Riverine vegetation removal,</td>
<td>✓ Plan for vegetated buffer zones with suitable indigenous tree species around the dam</td>
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<tr>
<td>− Biodiversity loss</td>
<td>- Damage to related aquatic biodiversity,</td>
<td>and along the banks of the rivers,</td>
</tr>
<tr>
<td>− Access to the river and livestock</td>
<td>- Disruption of existing access to the river by the</td>
<td>✓ Provide for approved direct access to the river upstream and downstream of the dam,</td>
</tr>
<tr>
<td>watering point</td>
<td>- Blockage of livestock watering and mineral eating</td>
<td>✓ Allow landowners disposal of trees and other vegetation on their land through</td>
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<td></td>
<td>locations</td>
<td>controlled commercial charcoal burning and charcoal briquette making,</td>
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<td></td>
<td>✓ Removal for offsite disposal all plant matter and organic residual for future water</td>
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<td></td>
<td>quality safety</td>
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<tr>
<td><strong>Site clearing</strong></td>
<td>- Pollution of water from human waste residuals,</td>
<td>✓ Undertake a controlled and supervised decomposition of pit latrines (current and</td>
</tr>
<tr>
<td>− Removal of houses, sanitary</td>
<td>- Pollution at waste disposal sites</td>
<td>abandoned) on the affected settlement locations,</td>
</tr>
<tr>
<td>facilities and cattle pens,</td>
<td>- Cultural aspects of graves relocation,</td>
<td>✓ Undertake a procedural relocation of all identifiable graves to locations pre-</td>
</tr>
<tr>
<td>− Relocation of graves</td>
<td>- Future effects to water quality from manure and</td>
<td>agreed and identified by each of the relevant families,</td>
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<td></td>
<td>biomass residuals</td>
<td>✓ Allow the landowners to dispose off manure from cattle pens at market rates,</td>
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<td><strong>Construction Works and</strong></td>
<td>- Siltation of river downstream of the dam,</td>
<td></td>
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<td><strong>related components</strong></td>
<td>- Lubricants and oil spills from construction</td>
<td>✓ Provide barriers or other measures to prevent discharge of silt downstream Tana river,</td>
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<tr>
<td>− Earth moving</td>
<td>machinery,</td>
<td>✓ Any oil spills from machines to be contained for safe disposal,</td>
</tr>
<tr>
<td></td>
<td>- Spoil materials disposal.</td>
<td>✓ Construction to stick to the schedule or shorter period</td>
</tr>
<tr>
<td><strong>Construction Works and</strong></td>
<td>- Possible intrusion to the local communities private</td>
<td>✓ Provide an awareness and sensitization forum for the workers as well as the</td>
</tr>
<tr>
<td><strong>related components</strong></td>
<td>life by foreign contractors,</td>
<td>neighbouring communities, especially on communicable social infections such as HIV/AIDS,</td>
</tr>
<tr>
<td>− Dam formation</td>
<td>- Migration into the project area (from within</td>
<td>TB, etc.,</td>
</tr>
<tr>
<td></td>
<td>project sub-county and other parts of the country).</td>
<td>✓ Sensitize the communities on co-existence with foreign workers.</td>
</tr>
<tr>
<td></td>
<td>- Potential social diseases transmissions including</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIV and AIDS</td>
<td></td>
</tr>
<tr>
<td>− Health and safety of workers and</td>
<td>- Safety of the workers and adjacent communities</td>
<td>✓ Provide workers with appropriate personal protective gear and enforce application of</td>
</tr>
<tr>
<td>communities</td>
<td>- Noise and vibrations from</td>
<td>the same at all times while at work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Project Activities | Environmental and Social Issues | Management Action Plans
--- | --- | ---
**Construction Works and related components**
- Machinery, materials and waste management
  - Construction machinery
  - Negative social interactions (cultural interference, immorality, etc.,)
  - Dust emissions and depositions into settlements and cultivated land,
  - Emissions from construction machinery into the atmosphere,
  - Waste discharges from construction camp sites
  - Material sites management.

- ✔️ Provide appropriate sanitation facilities and waste holding bins at the workers camps and other project areas
- ✔️ Involve local labour to the extent possible on the project construction activities.
- ✔️ Maintain all construction equipment in good operating conditions to reduce noise and emissions,
- ✔️ Earth moving and excavations be under damp conditions. Dry dusty materials be stored covered,
- ✔️ Material sites are fenced up for the safety of the neighbouring communities.

### Impacts during Operation Phase

### Project Activities | Environmental and Social Issues | Management Action Plans
--- | --- | ---
**Dam Operations**
- Sustainability and equity
  - Wastage of water especially if irrigation is allowed
  - Reduced opportunity to other potential dependents of Tana river downstream
  - Potential sand harvesting from the dam locations,
  - Unequal accessibility of water by all around the dam area (limitations in direct access the dam water)

- ✔️ Encourage residents to give priority to domestic and livestock for sustainable utilization of available water,
- ✔️ Irrigation should only be undertaken upon approval by relevant authorities and compliance with water resources management regulations,
- ✔️ Sand harvesting should only be undertaken at the approved sand interceptors upstream,
- ✔️ Provide safe locations for water abstraction and watering livestock for residents,

**Dam Operations**
- Safety risks at and downstream the dam
  - Injuries of the operators and visitors,
  - Safety risks of a dam break to downstream installations aquatic ecosystems, social and economic features.
  - Risks of drowning into the dam to children, the aged and livestock
  - Potential safety risks from wildlife (hippos, crocodiles and snakes)
  - Safety Risks Assessment of the cascade system

- ✔️ Undertake a safety risk assessment of project and safety audit of the entire cascade system as a whole and develop emergency response strategy,
- ✔️ Maintain a fence around the dam with provision for limited and/or controlled access to the dam water,
- ✔️ Enhance close surveillance for the community, especially those living on risk prone areas,
- ✔️ Sensitize the communities on dam safety issues associated with the dam, particularly in relation to settlements and institutional siting,
- ✔️ Provide safe water access points for the communities.

**Dam Operations**
- Social and economic issues,
  - Base Environmental flow must always be allowed downstream the dam,
  - Illegal water abstraction

- ✔️ Water abstraction for irrigation should be as permitted by ERMA
- ✔️ Sand harvesting to take place from authorized locations only (e.g. sand
<table>
<thead>
<tr>
<th>Project Activities</th>
<th>Environmental and Social Issues</th>
<th>Management Action Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Downstream dependants,</td>
<td>alongside the dam and wastage of water (especially if exposed for irrigation),</td>
<td>- Identify social linkages and collaborations with respect to water use through the CSR policy</td>
</tr>
<tr>
<td>• Water use trends and accountability,</td>
<td>- Sand harvesting from the dam area and upstream,</td>
<td>- Collaborate with WRMA and Ministry of Agriculture to facilitate easy and safe access to irrigation water by the local communities</td>
</tr>
<tr>
<td>• Facility Ownership</td>
<td>- Tree harvesting in the buffering zone</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Access to biodiversity resources in the area</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dam Operations</td>
<td>⊳ Contamination of water from the catchment and illegal direct access to the dam,</td>
<td>- Participate in the vector breeding control (mosquitoes, etc.),</td>
</tr>
<tr>
<td>• (Health and Sanitation)</td>
<td>- Vector breeding (mosquitoes, etc.),</td>
<td>- Participate in sensitizing the communities on protecting the water sources from pollution sources,</td>
</tr>
<tr>
<td></td>
<td>- Pollution discharging from settlements, operators quarters and markets into the dam,</td>
<td>- Participate in advising the communities on the need to boil or disinfect the water before use if obtained directly from the dam.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>⊳ Non-compliance with water abstraction regulations,</td>
<td>- Comply to the provisions of the Water Resources Management Authority,</td>
</tr>
<tr>
<td>• Institutional Aspects</td>
<td>- Natural Resources Utilization,</td>
<td>- Assist in organizing communities for effective and sustainable utilization of natural resources associated with the dam, e.g. wildlife.</td>
</tr>
<tr>
<td></td>
<td>- Water use linkages among the communities,</td>
<td>- Establish appropriate water user associations in the areas neighbouring the dam to collaborated sharing of the water resource,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Establish a specific monitoring system for the dam and its water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catchments’ Management</td>
<td>⊳ Effects of changing land use practices,</td>
<td>- Encourage immediate landowners to take responsibilities of the dam safety,</td>
</tr>
<tr>
<td>• Pollution control,</td>
<td>- Enhanced vegetation removal in the catchment,</td>
<td>- Immediate landowners to be motivated into maintaining buffer zones along the river banks and the dam itself,</td>
</tr>
<tr>
<td>• Runoff interception efficiency,</td>
<td>- Influenced sanitation trends in the neighbouring homesteads</td>
<td>- Consider participating in the global Tana River Catchment Management and influencing change in land use practices.</td>
</tr>
<tr>
<td>• Soil erosion control</td>
<td></td>
<td>- Provide additional sand traps where appropriate.</td>
</tr>
</tbody>
</table>

Assessment of Alternatives

- The ‘No Project’ Alternative: This option maintains the status quo: any social and economic development benefits from the project would be foregone and neither would there be the associated impacts on the environment.

- The various dam alternatives considered in the selection of the project option are the composite dam, with rockfill on the banks and RCC in the valley. The criteria used to choose the various alternatives included the availability of local resources and the environmental impacts that each alternative would have.
materials, anticipated costs, safety/geological hazards, safety/flood hazards and past experience. The clay Core dam is less attractive than the composite (RCC + Clay Core) Option.

- In terms of investment cost, a Composite dam is estimated at 940,000,000 USD; the Hardfill dam is estimated at 1,270,000,000 USD. Thus, considering the alternatives the best option selected for this project is the Roller Compacted Concrete (RCC) dam for construction in the valley with rock filled clay core dams out from both banks. The following are the design features of the proposed option:

- The four alternative scenarios assessed in terms of their economic impact on downstream values, and compared with the present situation as a baseline are as follows:
  - Maximum flood and sediment Release (MR)
  - Flood and sediment Release (R)
  - Flood Control (C)
  - Maximum flood Control (MC)

- These project alternatives were compared to a baseline of the current "without project" situation, of existing dams only. It should be noted that the Tana flooding regime has already been affected as a result of the existing dams, and downstream values have been degraded. Under a continuation of the present situation, this degradation will progressively worsen. Construction of additional dams without any flood release measures will aggravate and hasten this destruction (alternative C and MC). However, implementation of additional dam construction with flood release measures has the potential to, at least partially, reverse these negative impacts (alternative R), and at best significantly improve downstream values above the current situation (alternative MR). A project implemented with flood release measures implies significant economic benefits in terms of positive effects on downstream systems and values. With flood control, dam construction will impose a considerable economic cost on already degraded and vulnerable downstream systems.

- **Mitigation for the Proposed Option:** Mitigation measures, including best environmental management practices, have been recommended in this EIA report, and when diligently implemented will help to protect the physical, ecological and socio-economic environment of the affected project area.

**Environmental Management Plan**

Following the desk studies, field investigations and public consultations undertaken in this study, an Environmental management Plan (EMP) has subsequently been developed. The responsibility for the incorporation of mitigation measures for the project implementation lies with TARDA who must ensure that the Contractor implements all specified mitigation measures. The Supervising Engineer is responsible for assessing the Contractor’s environmental management plan.
Conclusions and recommendation

The primary objective of the High Grand Falls Project is to provide a large-Scale Multi-Purpose Water Reservoir catering for Public water Supply, Irrigation, River Regulation, Flood Control and Power Generation in order to effectively contribute to the regional and national social-economic development. Though the project there is acceptability and goodwill from the community living in the project area, there are significant environmental and social issues associated with the construction and operation of the proposed project. To that end, mitigation measures have been integrated in the components of the environmental management plan (EMP) in this report for consideration in the final design, construction and maintenance of the Dam.

A summary of the recommendations for the prevention and mitigation of potentially adverse environmental and socio-economic impacts are stated below:

 dez The proponent to implement the mitigation guideline provided in the environmental management plan;
 dez The RAP report of 2009 has been overtaken by events and hence requires review to update the list of project affected persons and cost estimates for the compensation and resettlement;
 dez Ensure that the families that are to be displaced by the project are resettled and assisted to regain their former livelihoods, or equivalent, in a reasonable period of time;
 dez Construction works in the planned project be carried out in accordance with approved designs, regulations, policies and laws;
 dez The Proponent should ensure rehabilitation of all sites that may be used for construction activities such as camps, sites for storage materials and any paths, tracks that may be established during the construction phase is done;
 dez The Proponent should ensure compensation of the persons who will be displaced by proposed project;
 dez The Operation and Maintenance of the proposed HGF Dam Project to comply with the best management practices and the principles of environmental management including the principles of sustainability, intergenerational equity, prevention, precaution and polluter pays;
 dez Ensure the sentiments expressed by the community under this report are integrated in the implemented plan of the project, especially where aspects of social interest are concerned;
 dez Institute effective communication, education and awareness towards the project beneficiaries for enhanced acceptability and social harmony;
 dez TARDA to undertake Environmental Impact Assessment Studies for all the proposed borrow areas of construction materials
 dez A complete audit be undertaken and submitted to NEMA a year after the project is commissioned to ensure that all the proposed mitigation measures have been complied with.

Overall, considering the proposed location, construction, management, mitigation and monitoring plan that will be put in place and the importance of this Dam, the development of this project is considered strategic and beneficial and should therefore be allowed to proceed.
CHAPTER 1: INTRODUCTION

1.1 Background
TARDA is proposing to develop a High Grand Falls Multi-Purpose Reservoir on river Tana. The project site is located 50 km downstream of the Kiambere Hydro Power Station along the River Tana in Tharaka-Nithi district, Eastern Province.

The GoK through the former Ministry of Regional Development Authorities (MORDA) commissioned a consortium led by Egis BCEOM International (France) in association with ISL (France), SCP (France), Egis BCEOM Kenya (Kenya) and CAS (Kenya), to undertake feasibility study, detailed design and tender documentation. On 20th January 2010 a service contract was signed between the MoRDA and the Consortium for the said works. The consortium completed the assignment by April 2012 and submitted the documents to MORDA.

TARDA now intends to commission development of this project and must undertake a full EIA study for the project. KenfaceEnconsult has therefore been contracted by TARDA to conduct the EIA, as per the TOR that were developed. The objective of this assignment is to ensure that the potentially adverse environmental and social impacts can be minimized and the positive impacts enhanced.

This ESIA project report provides relevant baseline information of the project area, anticipated impacts to the environment and social aspects, appropriate mitigation measures necessary for incorporation into the project implementation, as well as a comprehensive environmental management and monitoring plan.

Approval will, therefore, be sought on the grounds that environmental performance will be assured throughout the project phases through the implementation of the environmental management actions and monitoring programs recommended in this report and subsequent environmental audits.

1.2 Project Objectives
The main objective of the High Grand Falls Project is to provide a large-Scale Multi-Purpose Water Reservoir catering for Public water Supply, Irrigation, River Regulation, Flood Control and Power Generation in order to effectively contribute to the regional and national social-economic development.

The reservoir will provide large-scale water storage at the middle reach of the Tana River, thus making it possible to augment dry season flows for Lower Tana and allow increased draw off upstream.

1.3 Project Justification
In its present state, Tana River is incapable of meeting any major future water demands unless this Project is implemented. The reasons are:
The current Physical water unavailability in the dry seasons will preclude the planning of any new major irrigation developments either in the Upper or Lower Tana catchments unless there is increased Water storages and river regulation.

Development of needed public water supplies especially for the coastal tourist towns will only be possible at the expense of reduced hydropower production, from the existing schemes in the absence of High Grand falls.

Further Hydroelectric Power development potential downstream of the High Grand Falls site is inhibited by the lack of security against drought conditions.

The 200,000 hectares of virgin land at the Tana Delta can only be developed after the High grand Falls Dam is built.

The Tana River tributaries originating from the eastern and Some southern slopes of Mount Kenya are not regulated and are the main causes of the perennial flooding and destruction of the lower Tana districts. The High Grand Falls Dam and Reservoir is the only long-term option to control this situation.

Proposed intra and inter basin Water transfers shall only be realized with the High Grand Falls Reservoir.

The development of Tana and Athi river basins constitute major flagship projects in the Vision 2030.

1.4 Study Methodology

The approach to this exercise was structured such as to cover the requirements under the EMCA, 1999 as well as the EIA/Audit regulations as stipulated under the Gazette Notice No. 56 of 13th June 2003. It involved largely an understanding of the project background, the preliminary designs and the implementation plan as well as commissioning. In addition, baseline information was obtained through physical investigation of the site and the surrounding areas, public consultation (which included discussions with local administration and the community), photography, as well as discussions with the Proponent.

The key activities undertaken during the assessment were as follows:

(i) Literature Review: A detailed review of available documentation;
(ii) Consultations with the Proponent and regarding the proposed project details, the site planning and implementation plan;
(iii) Interviews and consultations with the local community surrounding the Dam as well as representatives of various organizations;
(iv) Data collection and physical inspections of the proposed site;
(v) Evaluation of the activities around the site and the environmental setting of the wider area through physical observations as well as from existing information in literature; and
(vi) Reporting, review and submissions.
Below is a typical outline of the basic EIA steps that were followed during this assessment:

**Step 1: Environmental Screening**

This is the first stage when the proposed project was evaluated guided by EMCA, 1999. In screening we try to confirm whether or not a particular project falls within a category that requires an EIA prior to commencement. Dams are listed under schedule 2 of EMCA, 1999 among projects requiring an EIA.

In addition, other considerations during the screening process included physical site location, environmental sensitivity of the areas surrounding the proposed site, nature of community and social activities in the project area.

**Step 2: Environmental Scoping**

Scoping, a result of a preliminary physical assessment of the site and its surroundings, helps to narrow down to the most critical environmental and social issues requiring attention for detailed evaluation. The EIA team conducted a reconnaissance survey accompanied by officials from TARDA whereby the latter provided an overview of the proposed project and took the team on a tour of the site. The scoping exercise concluded with a review of the Terms of Reference (TOR) that had been developed.

**Step 3: Desk Study**

Documentation review is a continuous exercise that involves a review of available documents on the project, including approved plans/designs, land ownership documentation, project plans and designs, environmental legislation and regulations, etc. The review provided an understanding of the terms of reference, environmental and social status, demographic trends, land use practices, development strategies and plans as well as the policy and legal documents.

**Step 4: Field Assessment**

With the background obtained from preliminary visits, discussions and documentation, the proposed project site was comprehensively evaluated and the administration and community interviewed. The proposed development was evaluated with a view to establish the physical environment status, social and economic trends. The field assessment was also designed to establish potential positive and negative impacts through interviews, discussions and physical observation.

**Step 5: Baseline Conditions**

Physical inspections and observations constitute the exercise for collecting baseline information.
Step 6: Consultations

Three approaches were used for the public consultation process: personal interviews with the local administration; public meetings with the local community; and a stakeholder workshop. Meetings with relevant government offices and consultations with the local community were undertaken to establish the general public opinion with respect to the project. Among the major issues addressed included social, economic benefits, values of the project and compatibility with other undertakings in the area as well as any other perceived impacts of the project to the welfare of the people.

1.5 ESIA Scope

The ESIA study has been designed in accordance with the terms of reference to address the following issues:

- To identify and assess all potential environmental and social impacts of the proposed project;
- To identify all potential significant adverse environmental and social impacts of the project and recommend measures for mitigation;
- To verify compliance with the environmental regulation and industry standards;
- To identify problems (non-conformity) and recommend measures to improve the existing management system;
- To assess compliance with Company’s corporate environmental policy requirements;
- To prepare an Environmental Impact Assessment Report compliant to the Environmental Management and Coordination Act (1999) and the Environmental (Impact Assessment and Audit) Regulations (2003), detailing findings and recommendations.
2.1 Project Location
The proposed High Grand Falls Multi-Purpose Dam Project will be located on the middle catchment of Tana River, at longitude 38°E and latitude 0°15’S; approximately 150 km north-east of Nairobi (straight line air distance). The site is approximately 50 km downstream of Kiambere Hydropower Electric Project and about 4 km downstream of the Grand Falls or the confluence of the Kathita and Tana River. The location of the site is shown in Figure 1. The Project lies within parts of Tharaka, Mwingi and Mbeere Districts.

Figure 1: Location of High Grand Falls
2.2 Design Concept

2.2.1 Overview
The project will draw its water from the Tana River; Kenya's largest river with a catchment area extending to some 100,000 km$^2$. The construction will consist of a dam with crest at an elevation of 555 m above sea level. The dam will be 115m high with a reservoir storage capacity of about 5.7 billion m$^3$. There will be three headrace tunnels, each with a diameter of 4 m and a length of 220m; an installed power of 500 MW, with three vertical Francis turbines.

2.2.2 River Diversion
Diversion tunnels and coffer dams will be provided to divert river water during the construction works of the dam.
Two fully concrete lined diversion tunnels, one 630 m long by 10.5m diameter and the other 760 m long by 10.5 m diameter, will be aligned on the left abutment of the dam. They are designed to release the flood river flow of 50-year probable flood with peak discharge of 2,800 m$^3$/s and a maximum velocity of 16.2m/s to prevent damage due to hydraulic erosion.

An upstream rockfill cofferdam, about 26m with a freeboard of 1m, a crest elevation of 466m will be provided between the inlet of the diversion tunnel and the main dam. A downstream rockfill cofferdam will be provided between the main dam and the outlet to of the diversion tunnel.

2.2.3 Main Dam and Reservoir

The proposed dam axis will be located about 4 km downstream of the Grand Falls. The dam will be a combined type consisting of the concrete dam at the riverbed section and rockfill at the abutments.

The concrete section is designed to have a vertical upstream face and an inclination of 1 to 0.8 on the downstream face. A gallery will be constructed at the low level section in the dam body for providing drain and grouting holes at the upstream dam foundation as well as an access to a normal flood and sediment release facility.

The rockfill dam (with centre core) construction will utilize rock fill materials that are available within the vicinity of the project silt. The dam is designed to have slopes of 1:1.8 and 1:2.0 on the upstream and downstream faces, respectively. The centre core will have a slope of 1:0.25 for both faces.

A 27 m high saddle dam on the right bank will have the same design characteristics as the main dam and will be located about 1 km away from it.

Table 1: Technical data

<table>
<thead>
<tr>
<th>Description</th>
<th>Capacity/measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam Height</td>
<td>115m from river bed (elevation 440masl)</td>
</tr>
<tr>
<td>Dam Crest Elevation</td>
<td>555masl</td>
</tr>
<tr>
<td>Total crest length of the main dam (both RCC and Rock Filled)</td>
<td>2,500m</td>
</tr>
<tr>
<td>Crest width</td>
<td>15m (to allow for construction of a road and a 1.5m parapet)</td>
</tr>
<tr>
<td>Total area to be covered</td>
<td>More than 165km$^2$</td>
</tr>
<tr>
<td>Anticipated volume of water</td>
<td>5.7 billion m$^3$</td>
</tr>
</tbody>
</table>

- Source: Final Design report of the HGF Dam Multipurpose project (May, 2012)

2.2.4 Spillway

A spillway, 105m wide with a chute length of 520 m, will be provided. It will be designed to discharge a 10,000-year probable flood and have sufficient freeboard to the dam crest. The spillway will be provided with six gates (each 15m wide by 15.5 m high) and an energy dissipater in form of a submerged bucket at the...
downstream end.

2.2.5 Artificial Flood and Sediment Release Facility:
At the concrete dam section on the right hand side of the spillway, an artificial flood and sediments release facility will be provided. It will consist of two sets of each 5 m wide by 5 m high steel conduit, a high pressure roller gate for operation control and a stoplog gate in front of the roller gate.

The facility is designed to replicate the normal floods of 1,100 m$^3$/s with a total volume of 490 million m$^3$. It is expected to release sediments which include sands and suspended loads associated with phosphate and organic matter.

2.2.6 Water Way
An intake structure will be located in the North (left) end of the main dam, adjacent to the spillway. Three concrete lined headrace tunnels/power shafts each of 3.38m diameter and 220m long will convey water to the powerhouse. At the bottom of the inclined section they will reduce to 3m before entering the powerhouse cavern.

From the powerhouse, the water will flow through three parallel 6.52 m diameter draft tube tunnels for a distance of about 50 m before merging into one 10.95 m diameter 400 m long tailrace tunnel. The draft tube and tailrace tunnels will be concrete lined.

2.2.7 Powerhouse
An underground powerhouse approximately 68 m long, 18m wide, 40 m high and 75 m below the ground surface will be constructed below the spillway structure. The structure will protect and insulate the electromechanical equipment. Access to the powerhouse will be through a 320 m long tunnel.

2.2.8 Permanent Access Road
A permanent access road to the project, about 53 km long and 6.0 m wide, will be constructed from the existing Kiambere Hydropower Project along the right bank of the Tana River. Along the road, nine concrete bridges (seven submerged type and two concrete girder type) will be constructed at the crossing points of the tributaries which flow into the Tana River.
2.2.9 Hydro-Mechanical Works
The Hydro-mechanical equipment will consist of the items listed in Table 2 below:

Table 2: Metal works

<table>
<thead>
<tr>
<th>Item description</th>
<th>Breadth/Diameter (m)</th>
<th>Height (m)</th>
<th>No. of Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversion tunnel closing gates</td>
<td>5.5</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Sand flush gates</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Spillway radial gate, hoist, stop log</td>
<td>14.5</td>
<td>15.5</td>
<td>6</td>
</tr>
<tr>
<td>Intake gates and trash racks</td>
<td>5.2</td>
<td>5.2</td>
<td>3</td>
</tr>
<tr>
<td>Penstock</td>
<td>6.9</td>
<td>N/A</td>
<td>100m long</td>
</tr>
<tr>
<td>Powerhouse gates, hoists</td>
<td>5.3</td>
<td>4.7</td>
<td>4</td>
</tr>
</tbody>
</table>

2.2.10 Generating Equipment
The Power Generating Equipment will operate under the following conditions:
- Gross Head -106.0 m
- Net Rated Head -101.0 m
- Maximum Plant Discharge -204.0 m³/s

The Equipment will consist of 6 No Francis Type Turbine and Generators with Installed Capacity of 500 MW and a Firm Output of 392.8 MW.

An outdoor switchyard to accommodate main switchgear and control equipment will be provided.

2.2.11 Transmission Lines and Substations:
The generated energy will be transmitted through new transmission lines to the existing Kiambere Power Station.

2.3 Project Cost
The constructions costs are each item are established by considering the local conditions, availability and suitability of construction equipment and materials. Costs are divided into Direct Construction and Indirect Costs. Direct Construction Costs include Preparatory Works, Civil Works, Metal Works, Generating and Substation Equipment, and Transmission Lines. Indirect Construction Costs include Engineering Services and Administration Expenses, Land Acquisition and Compensation, and Contingencies. The summary of the costs is as per Table 3:
Table 3: Project Cost

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Amount (US$'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Preliminaries</td>
<td>5,902</td>
</tr>
<tr>
<td>2.</td>
<td>Civil works</td>
<td>1,251,593</td>
</tr>
<tr>
<td>3.</td>
<td>Switch yard and instrumentation</td>
<td>32,839</td>
</tr>
<tr>
<td>4.</td>
<td>Transmission line</td>
<td>124,480</td>
</tr>
<tr>
<td>5.</td>
<td>Generating equipment</td>
<td>101,920</td>
</tr>
<tr>
<td>6.</td>
<td>Steel work</td>
<td>2,633</td>
</tr>
<tr>
<td>7.</td>
<td>Engineering services (5%)</td>
<td>75,968</td>
</tr>
<tr>
<td></td>
<td><strong>Total Baseline Costs</strong></td>
<td><strong>1,595,335</strong></td>
</tr>
<tr>
<td></td>
<td>Physical &amp; Price Contingencies (10%)</td>
<td>159,534</td>
</tr>
<tr>
<td></td>
<td><strong>Total HGF Costs</strong></td>
<td><strong>1,754,869</strong></td>
</tr>
</tbody>
</table>

- Source: Final Design report of the HGF Dam Multipurpose project (May, 2012)

2.4 Project Activities

The following works will generally be followed during the construction of the project:

- **Mobilization**: The contractor will provide access for the Construction Camp if it is not available. He will be required to clear and level the site by: cutting and clearing existing vegetation; removing stumps; leveling the site by grading and filling; and installing site drainage;

- **Setting out**: Once the camp, material storage and parking areas are established, the next task will involve setting out the works, marking and pegging for particular activities;

- **Site clearance and topsoil stripping**: These tasks will be done together with setting out. Areas may or may not be cut and cleared depending on the work area;

- **Earthworks, excavations, filling of structures, concrete works, drainage works**: The above tasks involving excavating, blasting and grading depend on the existing terrain and the foundation base required to build the particular component, although: concrete and steel will be used in various facilities or brought ready mixed; cofferdams may be required to restrict flow, hold back or divert water especially as the dam wall is raised; and erosion measures may be required upstream and downstream of the site; and

- **Handing Over**: At the completion of the works, all structures and equipment not required for the operation and maintenance are removed from the site and the work areas prepared for re-vegetation.

2.5 Project Inputs

2.5.1 Land

The construction activities will take place within the proposed project site that lies within parts of Tharaka, Mwingi and Mbeere Districts. The areas to be disturbed shall be the Contractor’s camp and the area to be cleared for the dam.
2.5.2 **Buildings, Sheds, Offices**

The Contractor will construct his temporary buildings, warehouses, storage facilities and spoils near the works during the construction period.

2.5.3 **Public and Worker Access**

The Contractor will maintain all access to the sites and provide temporary screens, fencing, hoardings, fans, planking footways, as may be necessary for protecting the public and others.

2.5.4 **Sanitary Provision**

The Contractor will provide and maintain sanitary facilities for labour to the requirements of the Government rules and regulations.

2.5.5 **Toilets/Latrines**

The Contractor will agree with the civil works supervisor the on the siting of toilets before construction. They will be constructed of a minimum standard of enclosed walls and roofs of corrugated metal sheeting.

2.5.6 **Utilities**

The Contractor will connect the following temporary services at the site:

- **Telephones**: The Contractor will provide a telephone in the site office for the joint use of the Contractor and the engineer;
- **Water Supply**: The Contractor will provide water from Tana river for the works; and
- **Lighting and power**: The Contractor will provide a supply of electricity and all equipment for lighting and power for distributing around the site.

2.5.7 **Labour Supply**

It is estimated that the total number of people will be 250 and will consist of the Contractor’s employees both skilled and unskilled.

2.5.8 **Construction material**

Construction input material will include gravel, rock, cement, sand, ballast, structural steel, reinforced steel, paint, timber, fuel and lubricants. Consumable materials will include lubricants, greases, chemicals, reagents, resins and others.

The construction of the dam will utilize rock fill materials that are available from the quarry sites within the vicinity of the project site. Investigations on the availability of and suitability of rock fill materials for rockfill dam and concrete aggregates were carried out by the following:

- Engineering and Power Development Consultants Ltd (EPDC) in 1979/1980, at Pre-Feasibility Study level, as part of their assignment on the Kiambere Hydroelectric Development Feasibility Study.

According to the EPDC and KNPDP reports, the residual soils have appropriate impervious core materials and are widespread on both banks of the river. During
the JICA study, 62 test pits trials, 30 auger borings, gradation analysis and laboratory tests were carried out.

The reports concluded that there are a lot of river bed deposits in the seasonal rivers that flow mainly from the right bank of the Tana River. Furthermore, quarry sites (borrow areas), comprising of granitic, and semi-felsic gneiss will be established on both banks of the River. The gneisses are in moderately to slightly weathered or fresh condition and have sufficient strength as the foundation rock for the dam. In certain areas, relative deep foundation excavation, in excess of 10 m in some places, will be required for the foundation because of the deep weathering of the rocks. Even though the permeability of gneisses is generally low, foundation treatment will still require for the foundation to improve locations with high leakage potential.

2.5.9 Rock Fill Materials
The table below indicates the required quantities of the Construction Materials required for the High Grand Falls Dam and the respective prospective sources:

<table>
<thead>
<tr>
<th>Material</th>
<th>Required Quantity (m³)</th>
<th>Source (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impervious core</td>
<td>2,900,000</td>
<td>Residual soils in the upstream area of the proposed dam site. The borrow areas shall be submerged by the reservoir to avoid environmental and other problems.</td>
</tr>
<tr>
<td>Filter and drain material</td>
<td>1,180,000</td>
<td>River bed deposits sand along the two seasonal rivers of Ngoru and Karange which are within an economical distances from the dam site</td>
</tr>
<tr>
<td>Inner shell (Weathered rock material)</td>
<td>650,000</td>
<td>Weathered rock material to be obtained from the various open and tunnel excavations required for the dam and related structures</td>
</tr>
<tr>
<td>Outer Shell (Fresh rock material)</td>
<td>17,400,000</td>
<td>Rock material to be obtained from the various open and tunnel excavations required for the dam and related structures as well as rock quarries at Tiamber and Kamuwongu Hills located on the right bank of the Tana River</td>
</tr>
</tbody>
</table>

Based on the study, four borrow areas (GC-1 to GC-4) for impervious material, two borrow areas of river deposits (GS1 and GS), and one quarry site for the filter, rock materials and concrete aggregates were found within 10 km from the proposed dam site.

2.5.10 Concrete Aggregates
Fine aggregates will be obtained from the river bed deposits along the two seasonal rivers of Ngoru and Karange while coarse aggregates will be acquired from the gravel found in the seasonal rivers but more will be produced by crushing plants to be established at the quarry sites.
CHAPTER 3: BASELINE CONDITIONS

3.1 Physical Environment

The sub-sections below provide brief descriptions of each environmental feature observed:

3.1.1 Physiography and Topography

The Tana River originates from Mt. Kenya, which lies at an elevation of 5,199 m above sea level (ASL). Its catchment covers some 100,000 km$^2$ (approximately 20% of the land area of Kenya) and stretches over about 1,000 km between the Kenya Highlands, with the peak of Mt Ol-Dolinyo at Kenya at 3,999 m asl, and the Indian Ocean. The total river length from source to the Indian Ocean is over 1,000 km. The river is fairly confined within its banks up to Kora Rapids.

The Tana River reaches the Kora rapids after flowing down about 100km from Grand Falls dam site and about 200m at the Kora rapids; creating a water head of about 250 m between the two locations. Thereafter the river runs through a vast alluvial flood plain and finally reaches the Indian Ocean after flowing down about 700 km. The main river channel which has a width of about 100m only meanders through a flood plain with a width of 3 to 4 km.

The following physiographic regions can be defined in the river basin:
  - An upper catchment (9,420 km$^2$ upstream of Kamburu with altitudes above 1,000masl;
  - A middle catchment (21,370 km$^2$ between Kamburu and Kora Rapids, with altitudes between 1,000 and 200 m ASL;
  - A lower catchment (65,160 km downstream of Kora Rapids, with altitudes below 200 m asl. The floodplain is included in this section.

3.1.2 Meteorology

In general, the upper Tana Catchment is blessed with high potential of water resources development, exhibiting high annual rainfall and lesser evapotranspiration which are attributed to the geographical condition.

The annual rainfall in the Tana basin varies from more than 2,000 mm in the mountainous areas located around the Mount Kenya to less than 300 mm in the low-lying areas near Garissa in the lower reach of the river. In the downstream reach of Garissa, the annual rainfall increases gradually to the river mouth where annual rainfall amounts to about 1,000 mm.

High annual rainfall of more than 2,000 mm takes place in the northern and western areas of the project catchment. In general, it decreases as the altitude goes down, coming to less than 800 mm after Masinga dam.

Climatologically, the Tana basin is characterized by the separate two rainy seasons which take place within a year. Usually, the first wet season occurs between March and May, while the second one between November and December. During these wet seasons, the rainy days last consecutively for 30 to 60
days, resulting in the occurrence of flood of long duration in the Tana mainstream. There is a general tendency that a heavier rainfall takes place in the first wet season rather than the later one, but the annual maximum discharges on the Tana mainstream were observed in either of the two wet seasons to date. Especially, this is endorsed by the recorded maximum discharge in the upper Tana basin, which took place in November 1961.

The annual evaporation in the Tana basin varies largely with altitude, ranging from about 2700 mm at the Garissa station with altitude of 138m to 1400 mm at the Sagana State Lodge station with altitude of 1,846 m. In most parts of the lower reaches, the annual evapotranspiration exceeds two times the annual rainfall.

Assuming that the annual evapotranspiration of the basin is approximated to be equivalent to 70 % of the annual Pan-A evaporation. Thus, the downstream areas in the Tana basin are completely dried up during the dry season.

### 3.1.3 Hydrology

The Tana has its origin in the Mount Kenya and Aberdares ranges. The southern and eastern areas of Mount Kenya and Aberdares drain into Tana River. The river system is divided into several sub-basins attributed to its tributaries and drainage pattern. The runoff observation at Regular Gauging Stations (RGS) has been carried out since the 1940's.

The project catchment area has 17,234 km2 at the Grand Falls dam site. The rivers/streams in the project catchment are divided into two types, namely the perennial rivers and seasonal rivers. The seasonal rivers appear in the area on the right bank side downstream of the Masinga dam, where the annual rainfall is less than 1,000 mm. in these seasonal rivers, no surface flow is seen during the dry periods. The last Perennial tributaries of Tana River, namely Mutonga and Kathita Rivers confluence with Tana just before the proposed dam site.

Downstream of the proposed site all the Tana River's tributaries are seasonal. The catchment area includes a wide range of climatic conditions and vegetation, including: alpine glaciers, afro-alpine moorland and high-altitude forest through to semi-arid and arid plains, and a humid coastal delta.

Data for River Gauging station (RGS) 4F13 about 2 kilometers upstream of the proposed dam site was used as control station for the study. The naturalized long-term daily runoff at the planned Grand Falls dam was estimated by the Tank Model, taking into account the availability of meteo-hydrological data. The mean discharge at the Grand Falls dam site (RGS4F13) for a period of 34 years from 1957 to 1990 was estimated to be 173 m3/s. The monthly average discharges are shown overleaf.

The flood hydrograph at the proposed dam site was presented by the Storage Function Model. The peak Flood discharges of the dam is 4,500 m3/ s for floods
with a 200-year return period and at 12,800 m$^3$/s for the floods with a 10,000-year return period without the upstream reservoirs.

3.1.4 **Geology in the Project Area**

The proposed dam will be a zoned type rock fill dam, and a combine type dam of a rock fill dam (right bank section) and a concrete gravity dam (river channel section).

The overburden in the dam site area consists mainly of residual soil which is generally a thin layer of 1-2m thick. Alluvial deposits are found in relatively small quantities narrowly along the Tana River and the river beds of small seasonal rivers in the surrounding area of the dam site.

Bedrock is composed of Archaean metamorphic gneisses of the Kenyan Basement System. Some intrusions of granitic rocks are seen in the gneisses. The main rock types are mafic gneiss which has generally good foliation. Granitic gneiss and semi-felsitic gneiss are also seen in some places. Granitic gneiss is less foliated than the mafic gneiss.

The bedrock is generally deeply weathered. The mafic gneisses tends to be the most highly weathered compared to the granitic gneiss and semi-felsitic gneiss. The results of the drilling investigation show that the bedrock is typically weathered to a depth of several meters up to a maximum of 18m approximately. Ridge topography and hills are generally formed by granitic gneiss or semi-felsic gneiss, and rather flat/wide and gentle slope are formed by mafic gneiss.

Foliation of the gneisses shows strike of consistently north-northeast/south-southwest and dip generally steeply to the west-northwest. Major joint structures also have generally similar strike and dip as the foliation. Other joint structures having a strike of west-east, similar direction to the flow Tana River and almost vertical dip, can be observed on the outcrops distributed along both banks of the Tana River.

The upper half of the left bank slope is rather steep, 20-30 degrees, where gneisses (highly to moderately weathered) are well outcropped. Moderately to slightly weathered gneisses are seen along both backs in the river channel. River bed deposit seems to be rather thin, several meters in maximum thickness. The right bank is formed by gently sloped hills with less outcrops of rock than that in the left bank.

3.1.5 **Sediment Load**

The mean annual sediment yield was estimated by simulating the daily runoff from 1957 to 1990 to the developed runoff-sediment yield curve, resulting in 2.62 million m$^3$/year or 0.152 mm / km$^2$/year at the dam site. The estimated Suspended Sediment Yield at SGS4F13 is shown overleaf.
The estimated sediment volumes of the High Grand Falls reservoirs are summarized as below:

**Table 5: Anticipated sediment volumes at Grand Falls Reservoir**

<table>
<thead>
<tr>
<th>Sediment inflow (10^6 m^3/yr)</th>
<th>Trap Efficiency (%)</th>
<th>Sediment Deposition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual Sediment</td>
<td>For 50-year Life</td>
</tr>
<tr>
<td></td>
<td>(10^6 m^3/yr)</td>
<td>(10^6 m^3/yr)</td>
</tr>
<tr>
<td>2.6.2</td>
<td>98</td>
<td>2.57</td>
</tr>
</tbody>
</table>

3.1.6 Vegetation

The proposed project area lies within agro-ecological Zone IV which does not favor the development of dense forest canopy except in areas near a water course. The vegetation within the project area are characterized by five distinct vegetation type’s namely wooded grasslands, woodlands, bushed thickets, open bushland and dense woodland.

**Thickets**

This vegetation type is not extensive and it contains closed canopies with trees higher than 15m. The thickets are mainly found near the water courses and around the Dam. Common tree species are *Acacia mellifera*, *Acacia tortilis* and *Commiphora spp*. The shrub layer within the thicket is dominated by *Acacia spp*, *Brevispica* and *Combretumdenhardtorum*. Common herbs are *Apilamossambicensis*. The banks of the Dam are sparsely wooded with different plant species. *Acacia atacacantha*, *Acacia mellifera* and *Commiphorasp* are the most common and dominant tree species.

**Wooded Grasslands**

They are characterized by *Combretum spp* which is the major tree species. Others are *Acacia drepanolobium*, *Acacia tortilis* and *Acacia senegal*. The most common shrub is *Grewiabicolor*, while common herbs include scattered *Triumfettaspp*, *Lantana Camara* and *Solanum incanum*.

**Woodlands**

Trees in this zone grow up to about 18m high and the dominant tree species include *Acacia mellifera*, *Acacia spp* and *Acacia brevispica*. Others include *combretum* species.

**Dense Bushland**

The bushland has scattered *Acacia tortilis*, *Acacia mellifera*, *Albiziaanthementica* as well as common herbs such as *Lantana camara* and *Solanum incanum*.

**Open Bushlands**

This zone is comprised of *Commiphora spp.*, *Acacia mellifera* and *Acacia tortilis*.
Wetlands Vegetation

Due to the unstable nature of the shore line, typical wetland vegetation has not been able to colonize a big portion of the Dam’s shoreline. Some of the wetland plant species recorded includes *Cyperus alpioroides* and *Cyperus rotunda* in the upper parts of the Dam. As a result of periodic silt deposits and inundation, the Masinga Reservoir draw down contains excellent grazing areas which are dominated by star grass (*Cynodon nlemfuensis*).

Agriculture and Crops Grown

Being in Agro Ecological Zone IV, the project area is not suitable for rain fed agriculture as the rainfall is low and erratic. Temperatures are also quite high, leading to high evapo-transpiration rates. Much of the area also has a very short cropping season and annual crops in the area are represented by maize, beans, cowpeas, green grams, bulrush millet and sorghum. Perennial crops include cassava, pawpaw, mangoes, citrus fruits and occasional bananas.

Rare threatened or endangered plant species:

No rare or endangered plant species have been recorded in the project area.

3.1.7 Animal Species

The main water catchment for the hydroelectric dams along Tana River is the Aberdare Range which also plays a critical role as a water catchment for the country. It is one of the five main “water towers” of Kenya. The forest host a number of threatened fauna species. The Jackson mongoose endemic to Kenya’s montane forests and the rarely seen golden cat are two threatened mammals. Other large endangered and threatened mammals of international conservation interest that occur in Aberdare forest are the bongo, giant forest hog, black rhino, elephant, leopard and African hunting dog. The forest is also rich in primates. The Aberdare is also internationally recognized as an Important Bird Area (IBA). The Range holds 52 of Kenya’s 67 Afrotropical highland species and six of the eight restricted range species in the Kenya montane endemic bird areas. The salient area is one of the most important conservation areas of the Aberdare National Park (Lambrechts, et al., 2003)

Much of the Aberdare is now surrounded by a seven strand electric fence. The purpose of fencing the ecosystem was to address human-wildlife conflicts, ensure security of the black rhino and protect the water catchment from human destruction.

The middle catchment is important due the five hydroelectric dams with Masinga Dam acting as the main reservoir for the other dams. Mwea National Reserve is also situated between Masinga and Kaburu Dams and is an important conservation area as well as a potential tourist attraction. Masinga reservoir is an important habitat for waterfowls that include Great Cormorant, white-winged tern, Abyssinian scimitar-bill, yellow-necked spur fowl among others. The dams are Important Bird Areas (IBA) in Kenya with over 260 bird species being recognized as residents or visitors to these habitats.
The region has a wide variety of wild fauna common to the eco-climatic region. Some large mammalian species that were common to this area before people settled heavily are the elephant (Loxodonta africana), African buffalo (Syncerus caffer), giraffe (Giraffa camelopardalis), burchell's zebra (Equus burchelli). Other mammalian species previously common to this area are bushbuck (Tragelaphus scriptus), bushpig (Potamochoerus porcus), kongoni (Alcelaphus buselaphus), Common waterbuck (Kobus ellipsiprymnus), dik-dik (Rhinocerotragus Kirkii), warthog (Phacochoerus aethiopicus), impala (Aepyceros melampus), lesser kudu (Tragelaphus imberbis), grey duiker (Cephalaphus jentinki), olive baboon (Papio anubis), spotted hyena (Crocodylus crocodylus) and black-backed jackal (Canis mesomelas). Most of these species are now confined within the adjacent Mwea National Reserve (MNR) which is electric fenced to minimize conflict. However, some of these species namely, bushpig, kongoni, lesser kudu, spotted hyena and the jackal are now locally extinct in MNR due to human factors ranging from hunting to competition and habitat destruction. The general locality is also home to over 73 bird species ranging from waterfowls to passerines.

The Tana basin occupies approximately 20% of the land area of Kenya and contains a similar percentage of the total human population. The river harbours the highest crocodile density in Kenya, which with proper management, can contribute to the country’s economy. At the middle reaches of the river, there are five hydroelectric Dams contributing virtually the entire national hydropower resources in the country (Table 2). The Dams are also important in crocodile resources, which are rarely exploited. There are, however, several reports on human attacks by these crocodiles within the Dams exacerbating human-crocodile conflicts along the Tana River. There are several reports on human injuries and deaths especially within the vicinity of Masinga Dam. Human deaths are compensated under the Wildlife Act, although the community would prefer a long lasting strategy to resolve the conflict.

Tana River also has the highest hippo population in Kenya where numbers increase from mid-stream to the lower reaches of the river. Several pockets exist along the river where the hippo population has been decimated owing to conflict with farmers. However, for areas which are still under natural conditions, the hippo population is high. Human encroachment along the river banks has reduced grazing areas for the hippo. Consequently, the animal has become a major conflict animal along the river where irrigated agriculture is being practiced.

Since the construction of the five hydroelectric Dams along the Tana River, the area has become an Important Bird Area (IBA) in Kenya. The Dams together with Mwea Irrigation Scheme are specifically important for water-fowls. Counts are conducted regularly to determine their trends and concentration points. HGF dam being the largest of the Dams is more important to conservation of the common water-fowls found in this area.
Fisheries along the Tana River may have had a minimal socio-economic and conservation value within the mid-reaches of the river before the construction of the hydroelectric Dams, especially Masinga. However, today, the Dams have become fisheries hotspots for adjacent communities and even the traditionally fishing communities. The proceeds from the fishing industry along these Dams are now a major source of income supporting diverse socio-economic needs of the people in the region. The major species of socio-economic value within Masinga Dam upstream of the proposed HGF dam are the common carp, Tilapia and catfish in that order. Others are the eel and elephant snout fish.

3.2 Socio-Economic characteristics

3.2.1 General Outlook
The profile covers the lower Tana Basin where the socio-economic impacts of the project will be most profound; from the project site down to the Indian Ocean coast. This is an area where the Tana River and its tributaries is the lifeline for more than 1.4 million people. It includes Mbeere and Mwingi districts upstream, Tharaka district midstream and Tana River, Garissa and Lamu districts downstream.

The region is inhabited by communities with different cultures and means of livelihoods; from the predominantly crop growing people of Mbeere through the mixed farming communities in Mwingi and Tharaka to strictly pastoral nomads of Garissa. The Tana River and its tributaries are their most important resource.

Table 6: Population and Poverty Status

<table>
<thead>
<tr>
<th>Area</th>
<th>Area Km²</th>
<th>Population</th>
<th>No. of Household</th>
<th>No. of Poor Households</th>
<th>No. of Non Poor Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mbeere</td>
<td>2092</td>
<td>202928</td>
<td>40234</td>
<td>17386</td>
<td>22848</td>
</tr>
<tr>
<td>Mwingi</td>
<td>10030</td>
<td>372123</td>
<td>60054</td>
<td>32177</td>
<td>27877</td>
</tr>
<tr>
<td>Midstream</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tharaka</td>
<td>1570</td>
<td>119323</td>
<td>21838</td>
<td>10148</td>
<td>11690</td>
</tr>
<tr>
<td>Downstream</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garissa/Ijara</td>
<td>44952</td>
<td>300621</td>
<td>53496</td>
<td>21248</td>
<td>32248</td>
</tr>
<tr>
<td>Tana River</td>
<td>38000</td>
<td>249368</td>
<td>37261</td>
<td>26895</td>
<td>10366</td>
</tr>
<tr>
<td>Lamu</td>
<td>6814</td>
<td>64972</td>
<td>12274</td>
<td>3277</td>
<td>8997</td>
</tr>
</tbody>
</table>

Socio economic conditions vary according to a wide range of factors but are mostly influenced by natural resources and their utilization. Development investment is also a major factor. Historically this region has received little investment and scant attention from successive governments and lag behind in almost all aspects of development (infrastructure, social amenities).

This low level engagement has left the communities to develop at their own pace. Some of the communities in the region are very conservative and continue with retrogressive practices that are inimical to development. For example female genital mutilation, though banned is still widely practiced albeit covertly to the detriment of the girl child personal development, education...
and wellbeing. General disenfranchisement of women denies them their rightful place and role in communities and is an obstacle to development.

3.2.2 Socio-Cultural Aspects

The project area is inhabited by four main ethnic groups including the Tharaka, Kamba, Kikuyu and Mbeere. Each of these ethnic groups consists of several clans and the social and cultural aspects in the project area are closely intertwined with Ethnic groupings.

Various public facilities exist in the project area including religious buildings and traditional ceremony sites, water, schools and social gathering sites and buildings.

3.2.3 Housing

The housing tenure in the project area consists of owner occupier homes. The houses are built of various materials depending on the sections including:

- Wall – majority of the houses are built of mixture of mud/wood while there is minimal use of stone, brick/block, mud/wood, mud/cement, corrugated iron sheets, grass/straw and cow dung.

- Floor – Earth is the commonest flooring material while other materials notably cement, wood and tiles respectively account for an insignificant number of house floors.

- Roof – Corrugated Iron sheets dominate as the main roofing material followed by grass/straw, cow dung, tin and makuti respectively.
CHAPTER 4: NATIONAL POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

4.1 General Overview
Environmental Impact Assessment is a tool for ensuring new projects and programmes incorporate appropriate measures to mitigate adverse impacts to the environment and peoples’ health and safety as well as enhancing sustainable operations with respect to environmental resources and co-existence with other socio-economic activities in their neighbourhood. Necessary policies and legislation that ensures annual environmental audits (EA) are carried out on every running project, activity or programme and a report submitted to National Environmental Management Authority (NEMA) for approval and issuance of relevant certificates.

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programmes that disregarded environmental sustainability. Following on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. The NEAP process introduced environmental assessments in the country with among the key stakeholders being industrialists, business community and local authorities. This culminated into the enactment of the Policy on Environment and Development under the Sessional Paper No. 6 of 1999.

4.2 National Policy Framework
Sessional Paper No 6 of 1999 on Environment and Development presents broad categories of development issues that require sustainable approach. Among the goals of the policy are:

- Incorporate environmental management and economic development as integral aspects of the process of sustainable development; and
- Encourage sustainable utilisation of resources and ecosystems for the benefit of the present generations, while ensuring their potential to meet the needs of the biosphere and future dependants.

Following on this, the policy outlines the following objectives among others:

- Conservation and management of the natural resources of Kenya including air, water, land, flora and fauna,
- Promotion of environmental conservation through the sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of future generations,
- Meeting national goals and international obligations by conserving biodiversity, arresting desertification, mitigating effects of disasters, protecting the ozone layer and maintaining an ecological balance on earth

4.3 National Legal Framework
Application of national statutes and regulations on environmental conservation suggest that the Proponent has a legal duty and social responsibility to ensure that the proposed development is carried out without compromising the status of the environment, natural resources, public health and safety. This position
enhances the importance of this environmental impact assessment for the proposed site to provide a benchmark for its sustainable operation.

Kenya has approximately 77 statutes that relate to environmental concerns. Most of these statutes are sector specific, covering issues such as public health; SOB erosion; protected areas; endangered species; water rights and water quality; air quality, noise and vibration; cultural, historical, scientific and archaeological sites; land use; resettlement; etc. Previously, environmental management activities were implemented through a variety of instruments such as policy statements and sectoral laws, and also through permits and licences. For example, the Physical Planning Act of 1996 empowers local authorities to request existing facilities to conduct environmental assessments, while under the Local Government Act of 1998, it is an offence to emit smoke, fumes or dust which may be a source of danger, discomfort or annoyance.

The key national laws that govern the management of environmental resources in the country have been briefly discussed below, although it is important to note that wherever any of the laws contradict each other, the Environmental Management and Co-ordination Act 1999 prevails:

4.3.1 The Environmental Management and Coordination Act, 1999
Part II of the Environment Management & Coordination Act, 1999 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment. In order to partly ensure this is achieved, Part VI of the Act directs that any new programme, activity or operation should undergo environmental impact assessment and a report prepared for submission to the National Environmental Management Authority (NEMA), who in turn may issue an EIA license as appropriate.

Part VIII section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. Section 73 require that operators of projects which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. Section 74 demands that all effluent generated from point sources be discharged only into the existing sewerage system upon issuance of prescribed permit from the local authorities or from the licensee. Finally, section 75 requires that parties operating a sewerage system obtain a discharge license from NEMA to discharge any effluent or pollutant into the environment.

Section 87 sub-section 1 states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while section 88 provides for acquiring of a license for generation, transporting or operating waste disposal facility. According to section 89, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste,
shall apply to the NEMA for a license. Sections 90 through 100 outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides.

Finally the environmental impact assessment guidelines require that the ESIA study be conducted in accordance with the issues and general guidelines spelt out in the second and third schedules of the regulations. These include coverage of the issues on schedule 2 (ecological, social, landscape, land use and water considerations) and general guidelines on schedule 3 (impacts and their sources, project details, national legislation, mitigation measures, a management plan and environmental auditing schedules and procedures.

4.3.2 TARDA Act, 2012
This is an Act of Parliament to provide for the establishment of an authority to advise on the institution and co-ordination of development projects in the area of the Tana River and Athi River Basins.
The functions of the Authority are:

a) to advise the Government generally and the scheduled Ministries in particular on all matters affecting the development of the Area including the apportionment of water resources;

b) to draw up and keep up-to-date, a long-range development plan for the Area;

c) to initiate such studies, and to carry out such surveys, of the Area as it may consider necessary, and to assess alternative demands within the Area on the resources thereof, including electric power generation, irrigation, wildlife, land and other resources, and to recommend economic priorities;

d) to co-ordinate the various studies of, and schemes within, the Area so that human, water, animal, land and other resources are utilized to the best advantage, and to monitor the design and execution of planned projects within the Area;

e) to effect a programme of monitoring of the performance of projects within the Area so as to improve that performance and establish responsibility there for, and to improve future planning;

f) to ensure close co-operation between all agencies concerned with the abstraction and use of water within the Area in the setting up of effective monitoring of that abstraction and use;

g) to collect, assemble and correlate all such data related to the use of water and other resources within the Area as may be necessary for the efficient forward planning of the Area;

h) to maintain a liaison between the Government, the private sector and foreign agencies in the matter of the development of the Area with a view to limiting the duplication of effort and to assuring the best use of technical resources;

i) to render assistance to operating agencies in their applications for loan funds if required;
j) to cause the construction of any works necessary for the protection and utilization of the water and soils of the Area.

4.3.3 The Forest Act
The Forest Act provides for the establishment, development and sustainable management, including conservation and rational utilization of forest resources for the socio-economic development of the country. Under Section 5 of the Act, the relevant functions that are applicable to the project are:

- Development of programmes and facilities in collaboration with other interested parties for tourism, and for the recreational and ceremonial use of forests, collaborate with other organizations and communities in the management and conservation of forests and for the utilization of the biodiversity
- Promote the empowerment of associations and communities in the control and management of forests.
- Enforcement of the conditions and regulations pertaining to logging, charcoal making and other forest utilization activities.

4.3.4 The Factories and Other Place of Work Act (Cap 154)
The Factories and Other Places of Work Act makes provision for the health, safety and welfare of persons at such workplaces. The Act is predominantly socio-economic in nature and focuses on the shop floor conditions of the factory, safety devices, machine maintenance, safety precautions in case of fire, gas explosions, electrical faults, provisions of protective equipment among others. In 2004, a subsidiary legislation (Legal Notice No.30) was enacted to provide for the formation of Safety Committees by the occupier of every factory or other workplaces. The Committee is responsible for all health and safety issues of enterprises including undertaking safety audits.

Part VI provides for the general welfare of the workers. Part VII section 51 states in part “In every factory or work place in which, in connection with any process carried on, there is given off any dust or fumes or other impurity of such a character and to such an extent as to be likely to be injurious or offensive to the persons employed, or any substantial quantity of dust of any kind, all practicable measures shall be taken to protect the persons employed against inhalation of the dust or fume or other impurity and to prevent it accumulation in any workroom, and in particular, where the nature of the process makes it practicable exhaust appliances shall be provided and maintained as near as possible to the point of origin of the dust or fumes …”.

Section 4 of Kenya subsidiary legislation of 2004, Legal Notice No. 31 of Kenya Gazette Supplement No. 25 of 24th May, 2004 of the Factories Act Cap 514, requires that, all factories or other workplace owners to establish a safety and health committee, which shall consist of safety representatives from the management and the workers. The number of the committee members will range from 3 to 7 depending on the size (number) of employees. The Act also requires the management to appoint a competent person who is a member of the
management staff to be responsible for safety, health and welfare in the factory or workplace.

Section 13 goes ahead to state that a health and safety audit of the workplace be carried out every twelve months by a registered Health and Safety Adviser. If the owner(s) or management contravenes any of the rules, he/she shall be guilty of an offence.

Part IV of the Factories Act. Chapter 514 addresses provisions concerning health. These provisions are to be enforced by the Department of Occupational Health and Safety of the Ministry of Labour.

Part V of the Factories Act elaborately deals with safety requirements, mainly from the point of view of avoiding accidents and injuries at work.

Noise Prevention and Control Rules: These rules are described in Legal Notice No. 25 of the Kenya Gazette Supplement No. 22 of April 2005 and state the noise regulations that apply to every factory, premises, place, process and operations to which the provisions of the Factories and Other Places of Work Act (Cap 514) applies.

Health and Safety Committee Rules: These rules are described in Legal Notice No.31 of the Kenya Gazette Supplement No.25 of May 14, 2004 and apply to all factories and other workplaces that regularly employ twenty or more employees. Among other items, the rules state that:

- The occupier of every factory or other workplace shall establish a Health & Safety committee; the Committee shall consist of safety representatives from the management and the workers;
- The occupier of every factory or workplace shall cause a health and safety audit of the workplace to be carried out at least once in every period of twelve months by a registered health and safety Adviser;
- The above legal notice also describes the functions and duties of the Health & Safety committees, meetings and minutes, and roles in the Committee. It further describes the duties of the occupier and those of the Health & Safety Adviser.

4.3.5 **The Public Health Act (Cap. 242)**

Part IX section 115 of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires Local Authorities to take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 and include nuisances caused by accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

4.3.6 **The Occupational Health and Safety Act (2007)**

This is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the
establishment of the National Council for Occupational Safety and Health and for connected purposes. The Act has the following functions among others:

- Secures safety and health for people legally in all workplaces
- Prevents employment of children in workplaces where their safety and health is at risk.
- Encourages entrepreneurs to set achievable safety targets for their enterprises.
- Promotes reporting of work-place accidents, dangerous occurrences and ill health with a view to finding out their causes and preventing of similar occurrences in future.
- Promotes creation of a safety culture at workplaces through education and training in occupational safety and health.

4.3.7 **Water Act (2002)**

Part II section 18 provides for national monitoring and information systems on water resources. Following on this, sub-section 3 allows the Water Resources Management Authority to demand from any person, specified information, documents, samples or materials on water resources. Under these rules, specific records may be required to be kept and the information thereof furnished to the authority on demand.

Section 25 of the Act requires a permit to be obtained for among others any use of water from a water resources, discharge of a pollutant into any water resource. According to section 29 of the same Act, application for such a permit shall be subject to public consultation as well as an environmental impact assessment as per the Environmental Management and Coordination Act, 1999. The conditions of the permit may also be varied if the authority feels that the water so used is causing deterioration of water quality or causing shortage of water for other purposes that the authority may consider has priority. This is provided for under section 35 of the Act.

Section 73 of the Act allows a person with a license to supply water (licensee) to make regulations for purposes of protecting against degradation of sources of water which he is authorised to take. Under the Act, the licensee could be a local authority, a private Trust or an individual and the law will apply accordingly under the supervision of the Regulatory Board.

Section 75 and sub-section 1 allows a licensee for water supply to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing water belonging to the licensee or which he is authorised to take for supply from being polluted. However, if the proposed works will affect or is likely to affect any body of water in the catchment, the licensee shall obtain consent from the Water Resources Management Authority.

One of the outcomes of the water sector reforms has been improved regulatory framework for water resource management and use. In addition to the Water Act 2002, the main document outlining the regulations is the Water Resource Management Rules 2007.

The rules set out the procedures for obtaining water use permits and the conditions placed on permit holders.

Sections 54 to 69 of the Water Resources Management Rules 2007 impose certain statutory requirements on dam owners and users in regard. These provisions address:

- Technical design report in respect of the water use permit;
- Operational information to be lodged with WRMA;
- Dam safety measures and requirements for inspections;
- Requirements for procedures to notify downstream communities in the event of unexpected releases.

Other sections within the rules imply that WRMA can impose water quality sampling requirements on TARDA in respect of the releases from the dam and impacts to the hydrology, water chemistry and river morphology from the proposed HGF Dam.

Section 16 of the Water Rules requires approval from the Water Resources Management Authority (WRMA) for a variety of activities that affect the water resources, including the storage of water in dams and pans. Approval by WRMA is conferred through a Water Permit. A permit is valid for five years and must be renewed.

Section 104 of the Water Resource Management Rules requires certain water permit holders to pay water use charges. The intention of the water use charges was to:

- Raise revenue for water resource management;
- Raise revenue for catchment conservation activities;
- Improve efficiency of water resource abstraction;
- Provide a system of data collection on water resource usage.

Catchment conservation is an activity that involves many stakeholders. The most important stakeholders are the land owners and users. These are the mainly small scale farmers. Catchment conservation efforts within the farming zones have been spearheaded by the Ministry of Agriculture, Soil and Water Conservation Branch. Earlier approaches and interventions at a small catchment level have been replaced by a livelihood improvement approach that seeks to empower farmers to improve production through improved soil fertility, better cropping practices, appropriate varieties, etc. However, catchment conservation efforts have frequently lacked a coordinated approach to deal with road drainage, forest management, agricultural and irrigation practices, etc. WRMA has been given the mandate with the Water Act to undertake catchment conservation and the
strategy adopted by WRMA, as expressed within the Catchment Management Strategy (CMS) is twofold:

- Improved coordination of stakeholders;
- Multi-sector interventions related to catchment conservation to be channelled through local stakeholder groups known as Water Resource User Associations (WRUAs). To support the WRUAs, WRMA and the Water Services Trust Fund have established a transparent framework to provide financial and technical support to WRUAs. This mechanism has been able to attract donor funds but has substantially failed to attract GOK funds and WRMA itself has only been able to make small payments into this system because of the lack of compliance by TARDA and other water users in respect of payment of water use charges.

The payment of water use charges is a mechanism to support water and catchment management. The water use charges can also be considered as a system of payment for environmental services (PES) if the revenues are ploughed back into the WRUAs and into catchment conservation activities.

4.3.9 Water Quality Regulations (2006)

The Water Quality Regulations (2006) are contained in the Kenya Gazette Supplement No 68, Legal Notice No 120. Of immediate relevance to the proposed facility for the purposes of this Project Report is Part II, Sections 4 - 5, as well as Part V Section 24.

Part II Section 4 states that “Every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution”

Part V Section 24 states that “No person shall discharge or apply any poison, toxic, noxious or obstructing matter, radioactive wastes, or other pollutants or permit any person to dump or discharge any such matter into water meant for fisheries, wildlife, recreational purposes of any other uses”.

4.3.10 The Wildlife (Conservation and Management) Act (Cap 376)

Part IX Section 62 to this Act provides for compensation for personal injury, death and loss of property by an animal. It states that any person who ‘suffers any bodily injury from or is killed by any animal, or suffers any damage to or loss of crops or property or in the case of a deceased person, any person who was dependent upon him at the date of his death, may make application to a District Committee…for the award of compensation for such injury or death or damage or loss’.

4.3.11 Physical Planning Act (Cap 286)

Section 24 of the Physical Planning Act gives provision for the development of local physical development plan for guiding and coordinating development of infrastructure facilities and services within the area of authority of County, municipal and town council and for specific control of the use and development of land. The plan shows the manner in which the land in the area may be used. Section 29 of the physical Planning Act gives the county councils power to
prohibit and control the use of land, building, and subdivision of land, in the interest of proper and orderly development of its area. The same section also allows them to approve all development applications and grant development permissions as well as to ensure the proper execution and implications of approved physical development plans. On zoning, the act empowers them to formulate by-laws in respect of use and density of development.

Section 30 states that any person who carries out development within an area of a local authority without development permission shall be guilty of an offence and the development shall be invalid. The act also gives the local authority power to compel the developer to restore the land on which such development has taken place to its original conditions within a period of ninety days. If no action is taken, then the council will restore the land and recover the cost incurred thereto from the developer. In addition, the same section also states that no person shall carry out development within the area of a local authority without development permission granted by the local authority.

Section 36 states that if in connection with development application a local authority is of the opinion that, the proposed activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an Environmental Impact Assessment report. The environmental impact assessment report must be approved by the National Environmental Management Authority (NEMA) and followed by annual environmental audits as spelled out by EMCA 1999. Section 38 states that if the local authority finds out that the development activity is not complying to all laid down regulations, the local authority may serve an enforcement notice specifying the conditions of the development permissions alleged to have been contravened and compel the developer to restore the land to its original conditions.

4.3.12 Local Government Act (Cap 265)

Part XI section 168 provides that every municipal council, town council or urban council may establish and maintain sewerage and drainage works within or without its area of jurisdiction. For purposes of the land required for such development, section 144 states in part “A local authority may, subject to the approval of the Minister, apply to the government or any other authority having power to acquire land required for purposes of any of its functions, to be acquired compulsorily for and on behalf of, and at the expense of the local authority”. The Act, however, does not indicate the repercussions of impacts on landowners.

Section 160 helps local authorities ensure effective utilisation of the sewerage systems. It states in part that municipal authorities have powers to establish and maintain sanitary services for the removal and destruction of, or otherwise deal with all kinds of refuse and effluent and where such service is established, compel its use by persons to whom the service is available. However, to protect against illegal connections, section 173 states that any person who, without prior consent in writing from the council, erects a building on; excavate or opens-up: or injures
or destroys sewers, drains or pipes shall be guilty of an offence. Any demolitions and repairs thereof shall be carried out at the expense of the offender.

Section 165 allows the local authority to refuse to grant or renew any license which is empowered in this act or any other written law on the grounds that the activity does not conform to the requirements of any by-laws in force in the area of such local authority the granting of the license would be contrary to the public interest.

For maintenance of such sewerage systems, the following relevant clauses have been drawn from section 169 of the Act that reads in part “A municipal council may for purposes of carrying out any drainage or sewerage works------”:

“------cause such sewers, drains and pipes to be made, altered, deepened, covered, laid and maintained either within or without as may be necessary for effectively disposing of the sewage and draining of its area ------”

“------carry such sewers, drains and pipes through, across, or under any public road, street, square or open place laid out for public road, street, square or open space without paying compensation and after giving 30 days notices in writing to the owner or occupier of the intention to do so ------”

“------from time to time alter, enlarge, divert, discontinue, close-up or destroy any sewers, drains, or pipes under its control ------”

Section 170, allows the right of access to private property at all times by local authorities, its officers and servants for purposes of inspection, maintenance and alteration or repairs. In addition, the municipal Council may establish and maintain sewage farms or disposal works, and dispose of the effluent therefrom, but shall not be liable for any nuisance or damage as a consequence of proper and ordinary conduct of the sewage farms or disposal works (section 171). To ensure sustainability in this regard, the local authority is empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and wellbeing of the inhabitants of its area as provided for under section 201 of the Act.

The Act under section 176 gives power to the local authority to regulate sewerage and drainage, fix charges for use of sewers and drains and require connecting premises to meet the related costs. According to section 174, any charges so collected shall be deemed to be charges for sanitary services and will be recoverable from the premise owner connected to the facility. Section 264 also requires that all charges due for sewerage, sanitary and refuse removal shall be recovered jointly and severally from the owner and occupier of the premises in respect of which the services were rendered. This in part allows for application of the “polluter-pays-principle”.
4.3.13 **The Land Planning Act (Cap 303)**
Section 9 of the subsidiary legislation (The development and use of land regulations 1961) requires that before the local authorities submit any plans to the Minister for approval, steps should be taken as may be necessary to acquaint the owners of any land affected by such plans. Particulars of comments and objections made by the landowners should also be submitted. This is intended to reduce conflict with other interests such as settlement and other social and economic activities.

4.3.14 **Building Code By-Laws**
The By-laws of Building code 3 (1) states ‘A person who erects a building or develops land or changes the use of a building or land, or who owes or occupies a building or land shall comply with requirements of these by-laws’. By-law 5 states that a person who intends to erect a building or materially change the use of a building or part of a building shall furnish the council in the manner provided in Part A of the First Schedule to these By-laws. Section 194 requires that where a sewer exists, the occupants of the nearby premises shall apply to the local authority for a permit to connect to the sewer line and that all wastewater must be discharged into the sewers.

4.3.15 **Occupiers Liability Act (Cap. 34)**
Section 3 requires that an occupier of premises owe the “common duty of care” to all visitors and workers. Rules of Common Law regulates the duty which an occupier of premises owes to his visitors in respect of danger and risk due to the state of the premises or to things omitted or attributes an affliction on his/her health to a toxic materials in the premises.

4.3.16 **Waste Management Regulations (2006)**
The Waste Management Regulations (2006) are contained in the Kenya Gazette Supplement No 69, Legal Notice No 121. Of immediate relevance to proposed development for the purposes of this project report is Part II, Sections 4(1-2), 5 and 6.

Section 4 (1) states that ‘No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle’

Sections 4 (2) and 6 explain that the waste generator must collect, segregate (hazardous waste from non-hazardous) and dispose waste in such a facility that shall be provided by the relevant local authority.

Section 5 provides methods of cleaner production (so as to minimize waste generation) which includes the improvement of production processes through: conserving raw materials and energy.
4.3.17 Land Acquisition Act (Cap. 295)
This Act provides for the compulsory or otherwise acquisition of land from private ownership for the benefit of the general public. Section 3 states that when the Minister is satisfied on the need for acquisition, notice will be issued through the Kenya Gazette and copies delivered to all the persons affected. Full compensation for any Damage resulting from the entry onto land to things such as survey upon necessary authorization will be undertaken in accordance with section 5 of the Act. Likewise where land is acquired compulsorily, full compensation shall be paid promptly to all persons affected in accordance to sections 8 and 10 along the following parameters:

(i) Area of land acquired,
(ii) The value of the property in the opinion of the Commissioner of land (after valuation),
(iii) Amount of the compensation payable,
(iv) Market value of the property,
(v) Damages sustained from the severance of the land parcel from the land,
(vi) Damages to other property in the process of acquiring the said land parcel,
(vii) Consequences of changing residence or place of business by the land owners,
(viii) Damages from diminution of profits of the land acquired.

4.3.18 The Limitations of Actions Act (Cap.22)
There is currently no law in Kenya that provides for recognition and protection of the rights or for compensation for loss of these rights for squatters. Squatters do not have legally recognized rights to public land which they occupy. The above provisions relate to compensation for those who have a legal right to land and whose land has been compulsory acquired for public purposes. However, if squatter have been in occupation of private land for over twelve (12) years, then they would have acquired rights as adverse possessors of that land as provided under the limitation of Actions Act, section 7. They would however need to seek a declaration from the High Court and prove that their entry into the land was open, without consent of land owner and was uninterrupted for 12 years if the land is Government land (as is the case for this project). Then they have no rights to it, as the doctrine adverse possession cannot be invoked against the government.

4.3.19 Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009
Part II section 3 (I) of these Regulations states that: no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment and section 3 (2) states that in determining whether noise is loud, unreasonable, unnecessary or unusual, the following factors may be considered-
(a) time of the day;
(b) proximity to residential area;
(c) whether the noise is recurrent, intermittent or constant;
(d) the level and intensity of the noise;
(e) whether the noise has been enhanced in level or range by any type of electronic or mechanical means; and,
(f) whether the noise can be controlled without much effort or expense to the person making the noise.

Part II Section 4 states that: except as otherwise provided in these Regulations, no person shall (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source.

Part III, Section 11 (1) states that any person wishing to (a) operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan, air-conditioning apparatus or similar mechanical device; or (b) engage in any commercial or industrial activity, which is likely to emit noise or excessive vibrations shall carry out the activity or activities within the relevant levels prescribed in the First Schedule to these Regulations. Any person who contravenes this Regulation commits an offence.

Section 13 (1) states that except for the purposes specified in sub-Regulation (2) hereunder, no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or steam or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the Second Schedule to these Regulations. These purposes include emergencies, those of a domestic nature and/or public utility construction.

Section 14 relates to noise, excessive vibrations from construction, demolition, mining or quarrying sites, and states that: where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose requirements on how the work is to be carried out including but not limited to requirements regarding (a) machinery that may be used, and (b) the permitted levels of noise as stipulated in the Second and Third Schedules to these Regulations.

It further states that the relevant lead agency shall ensure that mines and quarries where explosives and machinery used are located in designated areas and not less than two kilometers away from human settlements and any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do not exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source.

### 4.3.20 The Factories Act (Cap. 514)

This Act deals with factories and other places of work. Part VI provides for the general welfare of the workers with respect to supply of drinking water, washing...
facilities and first aid among other aspects. Related to the workers welfare, Part VII section 51 states in part “In every factory or work place in which, in connection with any process carried on, there is given off any dust or fumes or other impurity of such a character and to such an extent as to be likely to be injurious or offensive to the persons employed, or any substantial quantity of dust of any kind, all practicable measures shall be taken to protect the persons employed against inhalation of the dust or fume or other impurity and to prevent it accumulation in any workroom, and in particular, where the nature of the process makes it practicable exhaust appliances shall be provided and maintained as near as possible to the point of origin of the dust or fumes ……”.

Section 4 of Kenya subsidiary legislation of 2004, Legal Notice No. 31 of Kenya Gazette Supplement No. 25 of 24th May, 2004 of the Factories Act Cap 514, requires that, all factories or other workplace owners to establish a safety and health committee, which shall consist of safety representatives from the management and the workers. The number of the committee members will range from 3 to 7 depending on the size (number) of employees. The Act also requires the management to appoint a competent person who is a member of the management staff to be responsible for safety, health and welfare in the factory or workplace. Section 13 goes ahead to state that a health and safety audit of the workplace be carried out every twelve months by a registered health and safety adviser.

4.3.21 Irrigation Act (CAP 347)

Irrigation Act (CAP 347) was enacted in 1967 and applies only to public irrigation schemes managed by the National Irrigation Board. It is widely recognized that lack of a comprehensive irrigation policy and legal framework has constrained irrigation development in Kenya. Under the proposed new irrigation policy, the management of the proposed irrigation project will be required to operate under a legally recognized Irrigation Water User Associations whose duties will involve management of irrigation water, collection of operation and maintenance fees and conflict resolution.

4.3.22 Wildlife Conservation and Management Act (CAP 376)

This Act provides for the protection, conservation and management of wildlife in Kenya. This Act was introduced in 1976 and empowered the Director of Wildlife to protect animals and vegetation, both inside and adjacent to national parks and reserves. An amendment of the 1976 Act was enacted in 1989 establishing the Kenya Wildlife Services with the principal objective of managing the protected areas in arid and semi-arid lands (ASALs), to ensure conservation of the flora and fauna; and utilization of wildlife resources on a sustainable basis.

4.4 World Bank’s Safeguard Policies

This EIA is also based on internationally respected procedures recommended by the World Bank, covering environmental guidelines. Reference has been made to the Environmental Assessment Operational Policy (OP) 4.01, and Environmental
Assessment Source Book Volume II, which provides the relevant sectoral guidelines as discussed below.

The objective of the World Bank's environmental and social safeguard policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for bank and borrower staffs in the identification, preparation, and implementation of programs and projects. Safeguard policies have often provided a platform for the participation of stakeholders in project design, and have been an important instrument for building ownership among local populations. (World Bank, 1999-2006).

4.4.1 World Bank Safeguard Policy 4.01 – Environmental Assessment

The environmental assessment process provides insights to ascertain the applicability of other WB safeguard policies to specific projects. This is especially the case for the policies on natural habitats, pest management, and physical cultural resources that are typically considered within the EA process. The policy describes an environmental assessment (EA) process for the proposed project. The breadth, depth, and type of analysis of the EA process depend on the nature, scale, and potential environmental impact of the proposed project. The policy favours preventive measures over migratory or compensatory measures, whenever feasible.

The operational principles of the policy require the environmental assessment process to undertake the following:

(i) Evaluate adequacy of existing legal and institution framework including applicable international environmental agreements. This policy aims to ensure that projects contravening the agreements are not financed;

(ii) Stakeholder consultation before and during project implementation;

(iii) Engage service of independent experts to undertake the environmental assessment;

(iv) Provide measures to link the environmental process and findings with studies of economics, financial, institutional, social and technical analysis of the proposed project;

(v) Develop programmes for strengthening of institutional capacity in environmental management.

The requirements of the policy are similar to those of EMCA which aims to ensure sustainable project implementation. Most of the requirements of this safeguard policy have been responded to in this report by evaluating the impact of the project, its alternatives, existing legislative framework and public consultation.

4.4.2 Bank Safeguard Policy 4.04 – Natural Habitats

This safeguard policy requires that the study use precautionary approach to natural resources management to ensure environmental sustainability. The policy requires conservation of critical habitat during project development. To ensure conservation and project sustainability, the policy requires that:
(i) Project alternative be sought when working in fragile environment areas;

(ii) Key stakeholders are engaged in project design, implementation, monitoring and evaluation including mitigation planning.

4.4.3 Bank Safeguard Policy 4.11 – Physical Cultural Resources

This policy assists in preserving physical cultural resources and helps reduce chances of their destruction. The policy considers Physical Cultural Resources (PCR) to be resources of archaeological, paleontological, historical, architectural, and religious (including graveyards and burial sites), aesthetic or other cultural significance.

4.4.4 Bank Safeguard Policy 4.12 – Involuntary Resettlement

Resettlement due to infrastructure development is not a new phenomenon in Kenya but the government has no Policy Document or Act that aims at ensuring that persons who suffer displacement and resettlement arising from such development activities can be compensated adequately for their losses at replacement costs. The proponent plans to implement the World Bank’s Operational Policy 4.12 which has been designed to mitigate against impoverishment risks associated with Involuntary Resettlement and the restoration or improvement of income-earning capacity of the Project Affected People (PAP). The policy requires full public participation in resettlement planning and implementation and describes the conditions that borrowers are obliged to meet in operations involving involuntary resettlement.

4.4.5 Bank Safeguard Policy 7.50 – Project in Disputed Areas

It is known that projects in disputed areas may raise a number of delicate problems affecting relation not only between the bank and its member countries, but also between the countries in which the project is carried out. In order to reduce this impact, it is recommended any dispute over area earmarked for project development should be dealt with at the earliest possible stage.

4.4.6 World Bank Safeguard Policy BP 17.50 – Public Disclosure

This BP encourages Public Disclosure (PD) or Involvement as a means of improving the planning and implementation process of projects. This procedure gives governmental agencies responsibility of monitoring and managing the environmental and social impacts of development projects particularly those impacting on natural resources and local communities. The policy provides information that ensures that effective PD is carried out by project proponents and their representatives. The BP requires that Public Involvement should be integrated with resettlement, compensation and indigenous peoples’ studies. Monitoring and grievances address mechanism should also be incorporated in the project plan.
The proposed project incorporated public participation and stakeholders’ consultation as part of the E&SIA studies in order to collect the views of the host communities and their leaders for incorporation in the project mitigation plan.

4.5 National Administrative Framework

4.5.5 The National Environment Council
The National Environmental Council (the Council) is responsible for policy formulation and directions for the purposes of the Act. The Council also sets national goals and objectives, and determines policies and priorities for the protection of the environment.

4.5.6 The National Environment Management Authority
The responsibility of the National Environmental Management Authority (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment.

4.5.7 The Standards and Enforcement Review Committee
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).

4.5.8 Energy Regulatory Commission
Energy Regulatory Commission (ERC) was established as an Energy Sector Regulator under the Energy Act, 2006 in July 2007. ERC is a single sector regulatory agency, with responsibility for economic and technical regulation of electric power, renewable energy, and downstream petroleum sub-sectors, including tariff setting and review, licensing, enforcement, dispute settlement and approval of power purchase and network service contracts.

4.5.9 Key Institutional Organs
In summary, the key institutional organs of relevance to the proposed project are presented in 7:

<table>
<thead>
<tr>
<th>Institution</th>
<th>Parent Ministry</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pest Control Products Board</td>
<td>Agriculture, Livestock and Fisheries</td>
<td>Approval of any pest control products to be used.</td>
</tr>
<tr>
<td>Department of Crop Production</td>
<td>Agriculture, Livestock and Fisheries</td>
<td>Implementation of Agriculture Act</td>
</tr>
<tr>
<td>Directorate of Occupational Health</td>
<td>Labour, Social Security and Services</td>
<td>Inspection of the health and safety of the project</td>
</tr>
<tr>
<td>NEMA</td>
<td>Environment, Water and Natural Resource</td>
<td>Approval of EIA Study Report</td>
</tr>
<tr>
<td>WRMA</td>
<td>Ministry of Water and Irrigation</td>
<td>Catchment conservation and issuance of water abstraction permits</td>
</tr>
</tbody>
</table>
CHAPTER 5: ANALYSIS OF PROJECT ALTERNATIVES

5.1 Introduction
The consideration of alternatives is one of the more proactive sides of environmental assessment - enhancing the project design through examining options instead of only focusing on the more defensive task of reducing adverse impacts of a single design.

This calls for the comparison of feasible alternatives for the proposed project site, technology, and/or operational alternatives. Alternatives may be compared in terms of their potential environmental impacts, capital and recurrent costs, suitability under local conditions, and acceptability by neighbouring land users.

5.2 Alternatives including the Proposed Action
There are three options for this project, namely:

5.2.1 The ‘No Action’ Alternative:
Under the ‘No Action’ alternative, the Proponent would not carry out the intended construction works; the anticipated impacts resulting from commissioning and operation of the development as proposed, would therefore not occur. Additionally, any resultant socio-cultural/economic benefits that would be created by the proposed development would also be foregone.

There are three options for this project, namely:

5.2.2 Project alternatives

(1) Dam alternatives
The various dam alternatives considered in the selection of the project option are the composite dam, with rockfill on the banks and RCC in the valley. The criteria used to choose the various alternatives included the availability of local materials, anticipated costs, safety/geological hazards, safety/flood hazards and past experience.

The selection criteria for the various options is as shown in Table 1.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>RCC</th>
<th>Hard Fill</th>
<th>Clay core</th>
<th>Concrete face</th>
<th>RCC+Clay Core</th>
<th>RCC +Asphalt Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of local materials</td>
<td>+ (lot of cement)</td>
<td>+ (lot of cement)</td>
<td>++ (cement)</td>
<td>++ (cement)</td>
<td>+ (Asphalt imported)</td>
<td></td>
</tr>
<tr>
<td>Anticipated costs</td>
<td>+ (Deep excavation)</td>
<td>++ (cost of RCC)</td>
<td>++ (Cost of Lateral Spillway)</td>
<td>++ (deep excavation at up-stream plint)</td>
<td>+++</td>
<td>++ (cost of Asphalt)</td>
</tr>
<tr>
<td>Safety/geological hazards</td>
<td>+ (May require very deep excavations)</td>
<td>+++</td>
<td>++</td>
<td>+ (May require very deep excavations)</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Safety/flood hazards</td>
<td>++</td>
<td>+++</td>
<td>+ Spillway sensitive to flood</td>
<td>+ (Spillway sensitive to flood)</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>
Past experience | +++ | + (Very few past experiences of this size) | +++ | ++ (No past experience of this size) | +++ | + (Very few past experiences of this size)
TOTAL | 8+ | 10+ | 10+ | 8+ | 12+ | 8+

From the selection criteria in Table 8, the best alternative appeared to be the RCC+Clay core dam with the second best solutions both Hardfill and Clay Core with lateral spillway.

The clay Core dam is less attractive than the composite (RCC + Clay Core) Option. In terms of investment cost, a Composite dam is estimated at 940,000,000 USD; the Hardfill dam is estimated at 1,270,000,000USD. Thus, considering the alternatives the best option selected for this project is the roller compacted concrete (RCC) dam for construction in the valley with rock filled clay core dams out from both banks. The following are the design features of the proposed option:

**Table 9: Design features of selected option**

| Dam type | At the Valley: a RCC dam is well situated, so as to fit the hydraulic structures (spillway, intake). The foundation conditions are fair in the valley. On both banks, a rockfill dam with clay core. The dam is designed so as to withstand the Maximum Credible Earthquake.
| Spillway | The spillway is located on top of the dam, and equipped with tainter gates, this is the standard design on the River Tana and this is well adapted to the general hydrological conditions. the spillway is designed for the 1:10,000 years flood, and checked for the Probable Maximum Flood.
| Diversion tunnel and cofferdams | River diversion during construction is fulfilled by an upstream cofferdam and a double tunnel within the left bank, the diversion is designed for the 1:10 years flood. This somewhat light protection is adequate because of Kiambere dam upstream and because the RCC dam in the valley can withstand submergence during construction. It is also checked with the 1:50 years flood will not impact the rockfill dam.
| Foundation treatment | Foundation treatment involves grouting and drainage.

(2) **Alternatives based on economic impact on downstream values**

The four alternative scenarios assessed in terms of their economic impact on downstream values, and compared with the present situation as a baseline are as follows:

- **Flood Release:**
  - Alternative MR: Maximum flood and sediment Release
  - Alternative R: Flood and sediment Release
Flood Control:

- Alternative C: Flood Control
- Alternative MC: Maximum flood Control

The project alternatives represent a range of possible scenarios which will have differing impacts on downstream systems. These range from:

(I) **Best-case scenario:**
With dams implemented with maximum flood release measures, Tana flooding regimes will be reinstated and downstream systems will actually improve as a result of this.

**Worst case scenario:**
With dams implemented with maximum flood control (Tana flooding regimes will decrease still further and downstream systems will be rapidly degraded or destroyed).

These project alternatives were compared to a baseline of the current "without project" situation, of existing dams only. It should be noted that the Tana flooding regime has already been affected as a result of the existing dams, and downstream values have been degraded. Under a continuation of the present situation, this degradation will progressively worsen. Construction of additional dams without any flood release measures will aggravate and hasten this destruction (alternative C and MC). However, implementation of additional dam construction with flood release measures has the potential to, at least partially, reverse these negative impacts (alternative R), and at best significantly improve downstream values above the current situation (alternative MR). A project implemented with flood release measures implies significant economic benefits in terms of positive effects on downstream systems and values. With flood control, dam construction will impose a considerable economic cost on already degraded and vulnerable downstream systems.

5.2.3 **Mitigation for the Proposed Action**
Mitigation measures, including best environmental management practices, have been recommended in this EIA report, and when diligently implemented will help to protect the physical, ecological and socio-economic environment of the affected project area.

Commitments included in this Study report, as well as licenses and other authorizations that would be issued, are designed to avoid environmental damage in accordance with the Environmental Management and Coordination Act, 1999.

The Proponent undertakes to incorporate all necessary measures to ensure adverse impacts are mitigated to the maximum extent practicable during all the project phases.
CHAPTER 6: CONSULTATIVE PUBLIC PARTICIPATION

6.1 Overview

The Kenya government has enshrined the need for human societies’ involvement in project development in the Constitution. This has been set out in the EMCA Act, 1999 and Environmental (Impact and Audit) Regulations, 2003. As an important part of this exercise, consultations were undertaken as part of the Environmental Impact Assessment (ESIA) exercise process in order to obtain the views of members of the immediate community and interested and affected groups within the site’s immediate area of influence.

Public consultations for the proposed raising of HGF Dam were carried out in three phases designed to capture the key concerns of the communities as well as other stakeholders.

- Phase 1 of the consultations involved in-depth interviews with the local administration.
- Phase 2 comprised of consultative public consultations (CPCs) which were arranged and conducted on selected locations at the project area with participation drawn from the community leaders, administration, business community, farmers, landowners, institutional management, individuals, etc.
- Phase 3 consisted of stakeholder workshop with the local administration and government and sub-county line ministries

6.2 Schedule of consultative Meetings

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.09.2015</td>
<td>Kick-off meeting at Acting County commissioner's office</td>
<td>Meeting attended by the Acting County Commissioner, TARDA representatives and consultant staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acting county commissioner de-briefed on progress in the project and on the planned ESIA consultative meetings</td>
</tr>
<tr>
<td>4.09.2015</td>
<td>Planning Meeting at ACC’s office</td>
<td>Meeting attended by the DCM Senior chief and his assistant, consultants and the TARDA representatives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stakeholders identified, and schedule of community meetings discussed and agreed</td>
</tr>
<tr>
<td>9.09/2015</td>
<td>Consultative meeting with Sub-county</td>
<td>Attended by 15 representatives from the following offices:</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
<td>Participants</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>9.09/2015</td>
<td>Consultative meeting with Community Leaders at Chiakariga Social Hall</td>
<td>Total No. of participants: 160</td>
</tr>
<tr>
<td>10.09.2015</td>
<td>Meeting held at Kamanyaki Chief’s Camp</td>
<td>Total No. of participants: 147</td>
</tr>
<tr>
<td>11.09.2015</td>
<td>Community meeting at Kamaranti Primary School</td>
<td>Total No. of participants: 304</td>
</tr>
<tr>
<td>16.09.2015</td>
<td>Community meeting at Useini Chief’s office</td>
<td>Total No. of participants: 31</td>
</tr>
<tr>
<td>18.09.2015</td>
<td>Community meeting held at MarimanjiPolythenic</td>
<td>Total No. of participants: 202</td>
</tr>
</tbody>
</table>

Kick-off meeting at the county commissioners office

Planning meeting at the DCs office
6.3 Outcome of stakeholder’s consultative meetings
There is a general acceptance of the project by the majority of the communities living in the area and the major issues raised by the participants during these social interactions are summarized and listed below while sample submissions and minutes of the meetings are appended in this report:

6.3.1 Consultative meeting with Community Leaders at Chiakariga Social Hall
The following is a summary of the issues form the meeting:

⇒ The land titles for Kamanyaki and Kamarandi sub_locations are available.

⇒ Land demarcation for Chiakariga sub_location is done but not complete. Initial identification of the land owners has been done

⇒ For Magua location, land owners have been captured but there are disputes which are yet to be solved.

⇒ The leaders to be provided with the maps demarcating the areas that would be affected by the project

⇒ A compensation committee will be put in place to look into the issues and that the committee should consist of the national government representatives, county officials and the locals.

⇒ The same compensation criteria used in similar projects be employed for the High Grand Falls Dam
6.3.2 **Summary of Consultative meeting with Community members**

⇒ The community unanimously passed that they would not wish to be resettled in Usueni (an area initially designated for resettlement) instead be compensated and each community member to look for a suitable land of his/her choice.

⇒ The community meetings confirmed that the anticipated affected percentages per various locations to be as follows:
  - Chiakiriga Location - 10%
  - Kamarandi Location - 80%
  - Kamanyaki Location - 100%
  - Marimanti Location - 80%
  - Maragwa Location - 50%
  - Gituma Location - 50%

⇒ On displacement/ resettlement issues, the community is unanimously opposed to any other displacement model apart from compensation.

⇒ That 30% of the benefits accrued from the project should be channeled back to the county for development.

⇒ That the previous study reports to be availed the community.

⇒ The project implementation committee to be established during the project implementation period should have a good representation of the affected community from the affected locations.

⇒ Those community economic pillars like sand, dolm palm, animal manure from animals, cultural pillars e.g shrines be considered during compensation.

⇒ That where possible, 100% unskilled labour and 30% skilled labour be given to the local community members.

⇒ That TARDA should provide to the community the map that shows all the areas and people that will be affected by the project.
CHAPTER 7: ANTICIPATED IMPACTS AND MITIGATION MEASURES

7.1 Introduction
Development of large dams provides ecological as well as social challenges even though the ultimate facility is generally beneficial to the stakeholders and the country. Impoundment of large volumes of water has implications on the upstream systems through possible shifting of ecosystem boundaries upstream as a result of changes in water regimes. At the dam site and the inundated areas, implications ranges from slowed capacity for silt and pollutant transportation, loss and/or introduction of species, water quality changes, displacement of social and economic features and land use changes for the riparian landowners. Finally, downstream impacts are associated with regulated flows in the river, shifting of species to upstream areas, safety risks and land use changes due to the fluctuation in water regimes trends along the river basin.

The above concept guides the identification of the impacts associated with the proposed High Grand Falls Multi-purpose dam such as to focus on the following aspects;

(i) Hydrological patterns,
(ii) Hydraulic characteristics,
(iii) Water quality issues,
(iv) Geological trends,
(v) Aquatic ecosystems and habitat requirements,
(vi) Riparian land use trends and natural features,
(vii) Social trends (settlements, economic activities, cultural values, etc.).
(viii) Social trends including population and settlement dynamics, social integration and kinship relations, cultural values, displacement and relocation, gender equity and disease notably HIV/AIDS prevalence
(ix) Economic factors namely economic activities, poverty levels and livelihood changes

Impacts to the social and environmental aspects vary from one area to another around the project affected areas depending on specific settings. General impacts associated with High Grand Falls Multi-purpose dam development are discussed below:

7.2 Impacts during Construction
7.2.1 Positive Impacts
The following potential impacts have been identified during the construction phase:
(i) Employment generation and income opportunities for the contractor, construction staff, and other professional service providers; and
(ii) New business opportunities for the local community leading to the establishment of new trade centres and the growth of the existing ones especially where the contractors will establish their camps.
(iii) Provision of social amenities like schools, health centres, roads etc.

7.2.2 **Displacement of community at the project site**

Areas that will be directly impacted by the proposed reservoir include the area of inundation and the surrounding buffer zone. Area of inundation was calculated on the basis of the reservoir full supply level (FSL). Buffer zone was set at 100m from the FSL. People would be excluded from both of these areas. In addition, an area adjacent to and surrounding the proposed dam structures was added to enable the development of housing, offices and other structures required for the operation and management of the reservoir. These areas, termed the "Operations Zone" were defined to include all land area on the right bank of the Tana up to a distance of 1 km from the proposed dam. Although people would be living and operating within these areas, they represent a special case since existing residents/ farmers would be required to move.

The estimated population and corresponding households to be affected by the project is as follows:

**Table 10: Population to be displaced by the project**

<table>
<thead>
<tr>
<th>Sub-location</th>
<th>Location</th>
<th>% Area Submerged</th>
<th>Estimated Affected Population</th>
<th>Estimated Affected Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marimanti</td>
<td>Nithi</td>
<td>40%</td>
<td>2321</td>
<td>437</td>
</tr>
<tr>
<td>Kanyuru</td>
<td>Nithi</td>
<td>10%</td>
<td>404</td>
<td>70</td>
</tr>
<tr>
<td>Kamanyaki</td>
<td>Nithi</td>
<td>40%</td>
<td>1749</td>
<td>294</td>
</tr>
<tr>
<td>Kamarandi</td>
<td>Embu</td>
<td>15%</td>
<td>681</td>
<td>122</td>
</tr>
<tr>
<td>Thambu</td>
<td>Embu</td>
<td>10%</td>
<td>390</td>
<td>73</td>
</tr>
<tr>
<td>Iria-Itune</td>
<td>Embu</td>
<td>10%</td>
<td>332</td>
<td>63</td>
</tr>
<tr>
<td>Kirie</td>
<td>Embu</td>
<td>5%</td>
<td>227</td>
<td>58</td>
</tr>
<tr>
<td>Mukonga-Ikongo</td>
<td>Kitui</td>
<td>5%</td>
<td>209</td>
<td>34</td>
</tr>
<tr>
<td>Kamaindi-Kathungu</td>
<td>Kitui</td>
<td>10%</td>
<td>318</td>
<td>52</td>
</tr>
<tr>
<td>Gakombe</td>
<td>Kitui</td>
<td>50%</td>
<td>991</td>
<td>157</td>
</tr>
<tr>
<td>Gatue</td>
<td>Nithi</td>
<td>20%</td>
<td>868</td>
<td>148</td>
</tr>
<tr>
<td>Gatunga</td>
<td>Nithi</td>
<td>20%</td>
<td>704</td>
<td>120</td>
</tr>
<tr>
<td><strong>Total Affected</strong></td>
<td></td>
<td></td>
<td><strong>9,194</strong></td>
<td><strong>1,629</strong></td>
</tr>
</tbody>
</table>

Considering the above displacements, the population affected by the inundation in the reservoir area, inclusive of 100 m buffer zone, will need to be relocated.
Mitigation measures

(i) A resettlement plan must take into account a number of factors, including cost for resettlement, mitigation measures required to provide similar or improved living conditions for the resettled population and minimizing any adverse impacts on the host population.

(ii) Support the families that are to be resettled to regain their former livelihoods, or the equivalent, in a reasonable period of time.

(iii) Ensure that host populations are given the support they need to absorb the incoming populations without subjecting themselves to undue hardships. The infrastructure of the hosting community must be able to continue to provide the same level of services, or better, as those available before resettlement.

(iv) Preferences expressed by the local population should be honoured.

7.2.3 Loss of Vegetative Cover

The plant species of the study area present a unique plant diversity that is utilized extensively by the local community. Close to 20% of the total number of plant species in the study area, including trees, shrubs, herbs, grasses, climbers and lianas are commonly utilized by the local community to supply a wide range of needs.

During the construction phase of the project, bush and tree clearing will be undertaken in the areas to be inundated to minimize the impacts of water pollution from decaying vegetative matter that would die after inundation. Tree stumps will also be removed in an effort to reduce the incidence of trapping fishing nets after inundation.

Actual construction activities will lead to further loss of vegetative cover at the site of the construction camp for the workers who are likely to be engaged in the actual construction activities. This impact is however not expected to be significant.

While no endangered or threatened species were identified in the area, clearing and subsequent inundation constitutes a loss of biodiversity on flora. The vegetation is also home to many invertebrate and avifauna, who will be rendered dispossessed of their habitats.

Water backflow into the Rivers and other smaller streams that drain into the Dam as additional land is inundated will lead to loss of riparian vegetation in the area that will be permanently under water. This will however not have a significant impact.

Mitigation Measures

(i) Clear shrubs and trees that will be flooded by the proposed reservoirs. Integrate this with community oriented programmes of utilization
for building poles, timber, furniture, fuelwood and charcoal production to be carried out for the benefit of affected villages.

(ii) Undertake enrichment planting for the buffer zone where the vegetative cover is sparse;

(iii) Rehabilitate all sites that are being used for construction activities such as camps, sites for storage materials and any paths, tracks that may be established during the construction phase; and

(iv) Borrow pits established for provision of construction materials should also be rehabilitated.

(v) Initiate agro-forest programmes in the resettlement area in order to mitigate against the loss of firewood resources.

(vi) Create a buffer zone with minimal human activity round the proposed reservoir and replant indigenous trees in order to restore lost biodiversity.

7.2.4 Construction Waste Generation

During the construction phase various activities will be carried out and involve the demolition, excavation and transport of large amounts of construction materials. It is anticipated that during the materials transportation phase, the implications will be on the transport load of materials and the total transport distance, in the case of using the same transport machine. Generally, the total transport distance will reduce because the transportation of rock blocks in RFC could be transported from aggregate manufacturing plant to job site directly especially if located locally.

However, waste during the construction period will arise from: spoil during excavation work, deleterious material from aggregate screening; maintenance and repair of machinery; workers domestic waste; as well as waste water.

Therefore, the most appropriate options in waste management are: identification of the waste types; segregation into the various categories; and the establishment of suitable mechanisms for collection, storage, transfer, and final disposal.

Mitigation Measures

(i) Domestic solid waste to be stored in refuse bins temporarily before being taken away for proper disposal by NEMA licensed waste management firms;

(ii) Construction solid waste generated by activities that are unsuitable for use should be disposed in a landfill in an area that will be identified before commencement of construction activities. These areas should be covered with soil and the area later re-vegetated; and

(iii) Concrete, asphalt and other waste aggregate on site should be stored if there is a need for the material to be used as fill, provided that adjacent water bodies, including ground water supplies will not become impaired as a result of doing so.
Mitigation Measures for Liquid Waste:

(i) All waste water must be directed to a waste water treatment plant designed to meet the waste capacity before being discharged into the river;

(ii) An area for the disposal of spilled or excess concrete should be identified near the mixing site;

(iii) Waste water from concrete batching and aggregate screening should be discharged into nearby sedimentation pools and clean water reused;

(iv) A specific area for washing of cement trucks should be identified;

(v) Waste water from maintenance and the repair of machinery should be passed through an oil interceptor until the oil falls down to acceptable levels after which it can be discharged to a nearby river;

(vi) All equipment must be fueled at properly designed fueling stations. Oil and fuel extractions from storage areas should be supervised and routine inspections and maintenance be carried; and

(vii) All sewage and waste water from the construction camps and facilities will be disposed of in well designed and constructed septic tanks to meet the maximum population.

7.2.5 Soil erosion and increased sediment loads

Construction activities have the potential to loosen soils, particularly on slopes, which can then be washed down into the lower areas (streams and valleys) and soil quality degradation is also likely to occur during construction as a result of disposal of construction materials on the adjacent lands.

Mitigation Measures:

(i) Excavated earth should be held on locations of the site not susceptible to storm water runoff. The earth removed for external disposal should be deposited carefully on selected sites without the risk of being washed away during heavy rains and where such deposits will not compromise other land use activities in the areas affected; and

(ii) Re-vegetation of exposed areas around the site should be carried out rapidly in order to mitigate erosion of soil through surface water runoff and wind erosion

(iii) Construction of silt trap structures like terraces and check dams upstream

7.2.6 Water Quality Degradation

The selection and application of improper materials during the period of execution of construction works and use of improper technology, organization and mechanization for construction of the structures during the main and final works are direct entry points of pollutants into the water system.
For the purposes of public safety and the environment, the contractor must outsource materials from certified dealers dealing with construction materials already standardized and have passed quality test in accordance to the law. Therefore the developer shall be made to certify the sources of all materials to ensure their safety on environment and the community.

**Mitigation Measures:**
(i) Material with the following elements to be avoided at all cost:
   a) Asbestos in any form or any man made mineral fiber
   b) Lead paint or any other materials containing lead which may be inhaled, ingested or absorbed shall not be used
   a) Any timber treated with pentachlorophenol
   b) Any other substances regarded as being deleterious, construction materials which are not in accordance with requirements, codes of practice or with current accepted building practice at the time of specification or construction.

(ii) The prevention of downstream contamination from pollutants resulting from construction and operation and maintenance activities can be achieved by proper storage and ensuring all storage containers are well closed to prevent accidental leaks and spills; and

(iii) Proper management of oil spill and diligence on the part of the contractor during construction, refurbishment, fixing, installation and drilling shall reduce the risk of water contamination.

7.2.7 **Air Quality**
The following emissions will be expected to result from construction activities. This would in turn lead to poor quality of life as well as upper to lower respiratory infections and silicosis condition:
(i) Dust from excavations and earth moving vehicles as well as materials delivery);
(ii) Particulate matter from dry materials, more specifically sand, cement, gravel and murram, etc.), and
(iii) Emissions such as smoke, hydrocarbons and nitrogenous gases among others from machinery exhausts

**Mitigation Measures**
(i) Personal protective equipment (PPE) such as dust masks must be worn in the immediate vicinity of the operations during quarrying and handling of cement. Additional protective masks should be worn at the vicinity of drill sites;
(ii) The stockpiles of earth generated during construction works should be suppressed by spraying water or water based mixtures. Spraying should also be carried out on unpaved road accesses regularly and at handling sites for cement;
(iii) Controlling the suspension of dust drilling and blasting by sequential blasting, covering shielding or enclosing the area;
(iv) All machinery and equipment should be maintained in good working order to ensure minimum emissions including carbon monoxide, oxides of Nitrogen and Sulphur, as well as suspended particulate matter;

(v) Drivers of construction vehicles and delivery trucks should be cautioned to drive slowly near the site to avoid creating dusty conditions;

(vi) Construction trucks removing soils from the site, delivering sand and cement to the site should be covered to minimize dust blowing into the surrounding neighbourhood;

(vii) No burning of any materials whatsoever should be permitted at the site; and

(viii) Drivers of construction vehicles and delivery trucks must be supervised so that they do not leave vehicles idling and limit their speeds so that dust levels are lowered.

7.2.8 Risk of leaks and spills
Petroleum hydrocarbons present both an environmental and fire risk. The storage of petroleum hydrocarbons on site presents a hazard source and the release of hydrocarbons into the environment could result in significant impacts on a variety of receptors. The pathway for pollution is soil or water, and the primary receptors include the sub-soil and groundwater. Other receptors include air (from fuel vapours) and people (through dermal contact, inhalation or ingestion). It is however worth noting that the risks of a major oil spillages occurring are minimal.

Mitigation Measures:

(i) Regular maintenance of site equipment and machinery should be carried out to ensure any leakages are detected and controlled. The motor vehicles and heavy equipment should be serviced according to manufacturer’s requirements to limit the exhaust emissions.

(ii) Investigate the possibility of fitting catalytic converters especially for the heavy equipment to convert harmful substance in the exhaust fumes to less harmful substances;

(iii) Safety procedures for fuel storage and re-fueling should be well understood and implemented by site staff; and

(iv) Oil residuals including waste oil, lubricants, used filters, should be carefully collected and stored for safe disposal, in order to prevent migration of contaminant hydrocarbons into storm water or groundwater resources.

7.2.9 Occupational Health and Safety Issues
Potential impacts during construction include: exposure to physical hazards from the use of heavy equipment; trips and fall hazards; and exposure to dust and noise. The uncontrolled proximity to high vehicular traffic during transportation of construction materials and equipment may lead to injuries or fatalities due to traffic accidents. Other injuries or fatalities may result from workers operating...
equipment without adequate training or with a lack of personal protective equipment or extended exposure to outdoor weather resulting in heat-related lethargy.

**Mitigation Measures:**

(i) Ensure all equipment is inspected before use for appropriate safe guards and that the machine operators are trained on machine safety;

(ii) Ensure the working hours are controlled and that employees are not allowed to extend the working hours beyond an acceptable limit for purposes of gaining extra pay; and

(iii) Ensure the blasting and other high risk activities are carried out under access restriction. Only authorized persons are to access the blasting areas. Train first aid personnel and provide a fully stocked first aid box to respond to any injuries due to the activities.

The building of the embankment may cause the release of leachate (a mixture of water, decaying matter, soil and microorganisms) to flow through into water that may be used for domestic purposes by the neighboring communities. Leachate has the potential to contaminate water and thereby cause diseases and public health concerns. Other disease and public health problems may also arise during the construction phase from the contamination of water used for domestic purposes by project staff as well as neighboring communities by domestic waste (sewer and solid waste).

The consumption of contaminated water as a resulting from dam raising activities (equipment cleaning, use of biocides to kill bacteria in equipment) and extensive breeding of vectors in the impounded water may also contribute to disease and other public health concerns.

**Mitigation Measure**

(i) Ensure all contaminated water (as a result of equipment cleaning, use of biocides and domestic wastes) is contained, treated, tested and released after confirmation for fitness for consumption or disposed of appropriately by exhaustion to other municipal treatment site; and

(ii) Monitoring the quality of water and treating is the only mitigation for leachate.

The use of jack hammers for crushing rocks during the construction site may lead to whole body vibrations of the jack hammer operators which are likely causes of impaired functions of the chest, abdominal organs and the musculoskeletal system.

**Mitigation Measure:**

Avoid the use of jack hammers and employ other form of technology for crushing of rocks

The possibility of the Dam structure giving way and releasing huge quantities of the impounded water exists. If this sudden release occurs, project workers who
are not well versed with floating techniques may end up drowning. Due to the high volumes of water involved, the neighboring community, especially the one’s closest to the reservoir may also suffer a similar fate.

**Mitigation Measures:**

(i) Ensure structural integrity of Dam is checked during the construction phase.

(ii) Provide fall protection measures (harness with lanyard) to all project workers working in areas where drowning is likely to for recue purpose and

(iii) Ensure a predetermined path away from high population areas for the impounded water should reservoir structure fail

Due to the high vehicular traffic expected during the construction phase, it is likely that traffic accidents may become an important factor especially for children from neighboring communities crossing the roads leading to the project site.

**Mitigation Measures:**

(i) Ensure appropriate road safety signage is placed and drivers adhere to the requirements of such signage; and

(ii) Erection of bumps where human and vehicular traffic have high interaction opportunities

During the construction phase, several manual tasks will be carried out by the project workers. Repetitive tasks have the effect of imparting ergonomic disorders especially when they are carried out over long periods of time.

**Mitigation Measures:**

(i) Provide adequate manual labor to suffice the tasks; and

(ii) Eliminate repetitive task by semi-automation where possible

### 7.2.10 Noise and Vibration

There will be noise and vibrations generated during the construction phase but it will be no different from that on any other typical construction site. The noise impact during construction is expected to be negative and short-term.

Major sources of noises and vibration will come from: drilling during construction equipment to place charges; blasting to get aggregate; crushing to obtain aggregates and earthmoving machinery, as well as noise from the work force itself. The major receptors are expected to be the construction workers as well as any immediate neighbouring premises.

Excessive vibrational forces from blasting of hard granite rocks and the use of vibrators may impair functions of the chest, abdominal organs and musculoskeletal system as well as contribute to fatigue and decrease in concentration.
Excessive production of high noise by the blasting of hard granite rocks, rotating turbines, vehicular traffic and machinery operations may result in poor quality of life and potential loss (or reduction) in hearing.

**Mitigations Measures:**

(i) Conduct noise measuring to determine levels and extent of harmful noise and provide PPE (hearing protection) to persons who must operate within or visit the identified high noise areas;

(ii) Investigate the possibility of investing in silencers to reduce the quantity of noise produced;

(iii) Create a barrier well beyond the perimeter of the high noise level area to protect the unsuspecting public who may approach the project site;

(iv) Ensure that the works are distant from the settlement areas, and vibration is not expected to have impacts beyond its site boundaries;

(v) In order to meet noise level requirements, the works will be equipped with standard noise attenuation features. Machines that exceed acceptable noise limits will be equipped with silencers or lagging materials or specially designed acoustic enclosures; and

(vi) Inform local residents of any abnormal noise generating construction activities to minimize disruption to local residents.

**7.2.11 HIV/AIDS**

During the construction phase of the project, there may be an increase in the interaction of persons of both genders. This interaction may at times result in sexual relations with potential subsequent increase in HIV/AIDS infection rates.

**Mitigation Measures:**

The objective of the HIV/AIDS initiatives would be to reduce the risks of exposure to and spread of the HIV virus in the project area. Major targets would be construction workers, institutional communities and the general members of the community, particularly the youth. Recommended measures are as follows:

(i) Review the activities of the Dam construction to integrate with the HIV/AIDS campaigns;

(ii) Develop appropriate training and awareness materials for information, education and communication (IEC) on HIV/AIDS;

(iii) Identify other players (local CBOs, NGOs, and government organizations) on HIV/AIDS for enhanced collaboration;

(iv) Develop an intervention strategy compatible with the Dam construction programme to address success of the HIV/AIDS prevention and provide peer educators for sustainability in collaboration with other stakeholders; and

(v) Integrate monitoring of HIV/AIDS preventive activities as part of the Dam constriction supervision. Basic knowledge, attitude and practices are among the parameters to be monitored, and particularly on provision of condoms, status testing and use of ARVs.
7.2.12 Impact on Access Roads
Although it is anticipated that the existing accesses are adequate for the transportation of materials, the Contractor must maintain these roads during the construction period.

Mitigation:
(i) Traffic should abide by the speed limits and by-laws of the area;
(ii) Movement of heavy construction traffic should be planned appropriately.

7.2.13 Camp Sites
The project is likely to have three categories of camp sites, namely workers camps, operation camp (offices, stores and workshops) and material site camps (materials preparation sites). The anticipated impacts to the environment would be as follows:
(i) Workers camps associated with domestic wastes (sewage and garbage) running into water sources and land. People’s health would be at risk,
(ii) Construction materials holding and preparation sites with waste oils, bitumen residuals, machine parts, etc. that could infiltrate into water sources, land and air. Effects are mainly people’s health and physical environmental degradation,
(iii) Uncontrolled disposal of office wastes could also be a nuisance to the local inhabitants and the environment,
(iv) Material sites (gravel, hard stones, sand and water) have risks to people’s safety, environmental pollution and degradation among other undesirable occurrences.

Mitigation Measures:
(i) Exhaust and rehabilitate one material site before opening another section;
(ii) Provide PPE for employees (safety gears) and safety warnings for the public;
(iii) Exhausted quarries and borrow pits be isolated, protected and rehabilitated;
(iv) Hold top soils and vegetation matter near the quarries for backfilling;
(v) Ensure reduced stagnation of water in abandoned quarries and borrow pits;
(vi) Ensure controlled spoil dumping; and
(vii) Develop appropriate contractual agreement with landowners on conditions and terms of quarrying.

7.3 Impacts during Operations Phase
The following potential impacts have been identified during Operations Phase:

7.3.1 Positive Impacts
It is anticipated that the operations phase of this project will result in:
(i) Generation of 500 MW of hydropower to be injected to the national grid to boost the ability to meet the national power demand which so has been in deficit.
(ii) Floods control by impounding huge water volumes during the rainy season.
to stem floods which cause destruction downstream.

(iii) Increased irrigable area through river flow regulation. The initially coverage of the irrigation shall be 40,000 ha to be boost to 200,000 ha of irrigated agricultural land.

(iv) Provision safe drinking water for both human and livestock.

(v) Improved pasture for livestock relying on the by-products of irrigation projects such as rice straws, rice bran, banana trunks, expansion of grazing lands through release of artificial floods, changing the numerous laggahs found in the area and construction of furrows or channels cutting across some of the arid areas within the basin.

(vi) Fisheries development

(vii) Afforestation of about 20,000 ha within the buffer zone of the reservoir

(viii) Construction of a first class resort with provisions for water sports (surfing, fishing, sailing etc.), camping site, nature trails, cultural centre, golf course and game sanctuary for tourists attraction;

(ix) Capacity building and development of locals in develop and management of eco-villages and eco game sanctuaries to provide employment and improved livelihoods by tapping from tourism.

(x) Domestic and industrial water supply to Lamu for the LAPSET and to Tana River County for the Galana irrigation Project

(xi) The High Grand Falls Dam project provides for the construction of three navigable canals; one 60 km canal linking the Tana with EwasoNg’iro North, another 350 km canal linking to the Tana with Sabaki River at Baricho and the third 180 km canal originating from Naningi and entering the Indian Ocean near the proposed Lamu Port.

7.3.2 Increased sediment loading

There are two major concerns related to the sediment load of the Tana River. The primary engineering concern is that much of the sediment load will be trapped, reducing storage volume and defining the effective life of the reservoir.

In addition to the coarse and medium sediments carried out by the Mutonga and Kathita tributaries will settle within the reservoir. Mud trapping efficiencies of 15% have been estimated at Kiambere. It can be expected that this will be significantly higher for the larger High Grand Falls.

The downstream implications of sand and gravel trapping is increased stream erosivity immediately downstream of the reservoir and downstream of the Kora rapids, and a change in sediment load and composition affecting river morphology and suspended mud and associated organic matter and nutrients carried out downstream by flood water - that is thought to play an important role in maintaining the fertility of flood plains in the lower reaches of the Tana river.

Mitigation measures

(i) Rehabilitate all degraded land during and following completion of
construction activities.

(ii) Replant indigenous trees in order to restore lost biodiversity.

(iii) Carry out soil erosion measures, including terracing and planting of sediment binding grasses on exposed slopes and other surfaces.

(iv) Initiate a community oriented approach to the conservation of forests in the area. This should combine forest protection with access for activities such as bee-keeping and education.

(v) Initiate, and finance, a comprehensive community oriented land use management strategy in the project area.

(vi) Undertake further studies to establish the actual seasonal balance of sediment transport.

7.3.3 Water quality and deterioration

The water quality of the reservoirs and hence of the river downstream, is a result of the quality of the inflow and processes within the reservoir. The only real potential for managing water quality is to control discharge within the upper catchment, which is effectively determined by rural and urban land use. The water quality in the High Grand Falls reservoir is likely to be different than that of Kiambere, or the other up-stream reservoirs.

Water quality varies with the seasons, with generally higher quality discharge during the dry season when farming practices are limited, sediment load is low and there are no flash floods transporting non-point sources of contamination. However during the rains, there are high levels of contamination, including both physical and chemical, and most significantly biological and bacteriological from both the Mutonga and the Kathita rivers and the discharge from Kiambere.

The discharge contains both phosphates and nitrates. The implication is that there will be a slow buildup of nutrients in the reservoir, which would support high primary productivity and could encourage fish production. However, algal blooms are unlikely to be a major problem, as they will be limited by the availability of phosphate which is expected to be strongly locked onto clay particles and will be deposited in bed sediments.

Mitigation measures

(i) Improved treatment and waste management should be considered for the upper catchment.

(ii) Ensure there is improved treatment for communities relying on water discharged from the reservoir.

(iii) Periodically sample water, test, treat and release

(iv) Discourage use of untreated water from the reservoir for domestic use

7.3.4 Impact on Diversity

Human alteration, modification and conversion of natural vegetation for agriculture, livestock and other forms of development have driven most terrestrial mammalian species to local extinction. However, terrestrial birds that are
commensurate with human development are still abundant in the area. The following impacts are therefore anticipated from the proposed HGF Dam:

- None or minimal impact on any existing mammalian species compared to the loss precipitated by human conversion or modification of the environment;
- Conducive environment for the common carp, tilapia, catfish and the elephant snout-fish that are available at Masinga Dam-upstream of the dam. This is because the Dam construction will have an effect of food resource concentration and provision of adequate habitat for major fishes found here. The proposed project will therefore have minimal or no negative impacts; and
- Increased human settlement along the Dam shoreline may lead to overexploitation of fisheries resources within the proposed dam.

**Mitigation measures**

(i) Regulation of fishing gear by the Fisheries Department to minimize misuse and overexploitation

(ii) Regulate and improve marketing structures to maximize profit and improve livelihoods of the community and earning to Fisheries Department.

### 7.3.5 Impact on Hippos and Crocodiles

Although the hippo population trends along the river are not available, its number has been on decline as is the case elsewhere in the country. Its population has drastically declined in areas where agricultural activities are prevalent as well as areas of irrigated agriculture incursion in the dry areas near the major rivers. The proposed HGF Dam is no exception as people move from high potential agricultural areas into dry-lands to practice irrigated agriculture near major rivers to meet their food requirements due to burgeoning human population. The HGF Dam will became an important settlement area for riverine based irrigated agriculture resulting in an increase in the density of riverine farmlands around this Dam. This will precipitate hippo-human conflict as the natural vegetation is replaced by crop-fields that are even more attractive to hippo. Thus, there will be few human-hippo encounters resulting into human injuries and deaths.

With regard to crocodile numbers and menace, with the proposed Dam, there will be ripple-effect on conflict management owing to increasing crocodile numbers in the dam. The conflicts will be manifested through human and livestock injuries as well as deaths. The impacts will require strategies that will minimize conflicts and ameliorate the community to facilitate co-existence.

**Mitigation measures**

Kenya Wildlife Service in conjunction with communities’ and other stakeholder should develop a management plan that will include the following:

(i) Sustainable utilization of crocodile resources at mid-stream reaches of the river and specifically targeting the proposed Dam. The aim would be to collect crocodile eggs, hatchlings and breeders for ranching within the existing crocodile farm;
(ii) Control rogue crocodile by either shooting (PAC) or captures for breeding stock;

(iii) Create awareness on the crocodile as a natural resource that may contribute to communities’ livelihoods;

(iv) Out-growers programmes targeting the community to collect crocodile eggs and manage hatching for commercial sales to existing crocodile farms; and

(v) Facilitate community owned and managed crocodile enterprises in the vicinity of the proposed Dam.

(vi) Create awareness among community members on the need to create a buffer zone between the dam and irrigated field to provide graze for the hippo;

(vii) Use of a moat around irrigated crop fields to minimize hippo incursions into crop fields; and

(viii) Control of notorious problem animal through PAC programme.

7.3.6 Impact on Terrestrial Mammalian Species

Human alteration, modification and conversion of natural vegetation for agriculture, livestock and other forms of development have driven most terrestrial mammalian species to local extinction. However, terrestrial birds that are commensurate with human development are still abundant in the area. Further development of the proposed Dam will have none or minimal impacts on any existing mammalian species compared to the loss precipitated by human conversion or modification of the environment.

Mitigation Measure

(i) Community education and awareness on benefits of wildlife conservation and management especially for non-conflict species;

(ii) Awareness creation on HGF Dam as a tourist attraction, which can be combined with wildlife based tourism; and

(iii) Wildlife drives into MNR for those that escape and PAC for those that might turn-out as habitual crop raiders

7.3.7 Impacts on Water Fowl

Since the construction of the five hydroelectric dams along the Tana River, the area has become an Important Bird Area (IBA) in Kenya. The dams together with Mwea Rice Irrigation Scheme are specifically important for water-fowls. Counts are conducted regularly to determine their trends and concentration points. HGF being the largest of the dams, is more important to conservation of the common water-fowls found in this area. Increasing the coverage of the dam will further elevate the area as an IBA in Kenya and the region at large.

Mitigation measures

(i) Create awareness on the socio-economic and environmental importance of the waterfowl birds; and
(ii) Awareness creation targeting the community on benefits of conserving the water-body for tourism activities combining both boat rides and bird viewing.

7.3.8 Impact on Fisheries

The HGF reservoir will be situated in a valley that has total command of the Kathita and Mutonga Rivers from Mount Kenya. These rivers will deposit in HGF reservoir a significant amount of silt which will create characteristics of an upper reservoir. From the Kiambere dam, the HGF reservoir will receive clear water with negligible sediments. This situation will favor the development of a fishery resource for the HGF reservoir that will most likely allow the proliferation of both pelagic and benthic fish species. This will essentially be a common carp-Tilapia fishery likely to perform much better than the existing upstream reservoirs.

The potential fish productivity of the HGF reservoir can be assumed to fall in line with the Masinga reservoir estimates. This would work out to about 800 tonnes of fish per annum on sustainable basis. This estimated fish production however should be augmented by aquaculture activities to contain factors that may limit the expected annual off take from the lake.

The upgrading of the dam may result in the following negative impacts:

(i) Increase human settlement along the dam shoreline; and
(ii) Overexploitation of fisheries resources within Dam.

Mitigation measures

(i) Regulation of fishing gear by the Fisheries Department to minimize misuse and overexploitation;

(ii) Regulation of settlement along the dam shoreline by TARDA;

(iii) Improvement of marketing structures to maximize profit and improve livelihoods of the community and earning to Fisheries Department; and

(iv) Monitoring of biological and chemical parameters in the water and in aquatic biota will be vital in alerting the Proponent, relevant Government Agencies and local communities to potential public health hazards, such as elevated mercury concentrations in fish tissues.

7.3.9 Loss of Grazing Grounds

The proposed reservoir area is currently being used as grazing grounds by the community. Upon inundation, these grazing grounds will no longer be available to the livestock. Livestock rearing is expected to reduce as more land is put under agriculture with use of increased dam water supply. However, casual livestock immigration from other areas is likely during drought and this may lead to environmental destruction.

Mitigation measures:

- Discuss with the local communities about alternative sites for grazing and advise them on ways and means to develop such alternatives.
7.3.10 Occupational Health and Safety Issues
The following occupation health and safety impacts have been identified during operations and maintenance:

1) Any sudden release of impounded water due to the failure of water control mechanisms may lead to death (or injury) from drowning. Alternatively, there is a likelihood of the reservoir structure giving way and releasing huge quantities of the impounded water;

*Mitigation measures:*
(i) Ensure structural integrity of reservoir is checked during the operations phase;
(ii) Provide fall protection measures (platforms) in areas where drowning is likely; and
(iii) Ensure a pre-determined path away from high population areas for the impounded water should reservoir structure fail

2) Accidental drowning into the dam sections is a potential occurrence affecting children, the aged as well as animals

*Mitigation Measures:*
(i) Awareness creation on the importance of dam safety;
(ii) Provision of designated points of access for recreation and water abstraction; and
(iii) Improvement on security surveillance within and around the project site.

3) Consumption of contaminated water may result in poor health, incapacitation or death;

*Mitigation Measures:*
(i) Periodically sample water, test, treat (where possible) and release; and
(ii) Provide alternative treated water fit for consumption and discourage the use of untreated water from the reservoir for domestic uses

4) Extensive breeding of vectors in the impounded water may cause vector borne diseases within the community surrounding the reservoir. Some of the most common vector borne diseases includes bilharzias, malaria, typhoid and dysentery.

*Mitigation Measures:*
(i) Promote primary health care practices, with the assistance of the Ministry of Health; and
(ii) As part of Corporate Social Responsibility (CSR) and where possible, liaise with the Ministry of Health to facilitate requests for health provisions (such as mosquito nets) and other medical services

5) The water drop and rotating turbines may produce noise at levels which may cause a reduction in quality of life or reduced hearing at a worst case scenario;
Mitigation Measures:

(i) Conduct noise measuring to determine levels and extent of harmful noise and provide hearing protection to persons who must operate within the identified high noise areas;

(ii) Consider the possibility of investing in silencers to reduce the quantity of noise produced, and

(iii) Create a barrier wall beyond the perimeter of the high noise level area to protect the unsuspecting public who may approach the project site.

6) Decaying vegetation from the clearing of land during the construction phase may cause the release of previously unavailable (inorganic) mercury in the form of organic mercury (methyl mercury) as a result of microbial action on the decaying vegetation. The organic mercury (mainly methyl mercury) is easily absorbed into the tissues of fauna (fish) and if this contaminated fauna is consumed by the communities around the reservoir, it could lead to mercury poisoning. Mercury poisoning may be fatal or lead to poor health and incapacitation.

Mitigation Measures:

(i) Ensure vegetation is promptly removed from the reservoir to avoid decay and transformation of inorganic mercury to organic mercury; and

(ii) Periodically sample and test the fauna utilized as diet by the surrounding community to determine levels of methyl mercury and issuing alerts whenever levels are unacceptable.

7) Proximity to strong electromagnetic fields such as the immediate power lines from the power generation station may lead to exposure to high electromagnetic fields. Electromagnetic field exposure is known to cause alterations in heart rhythm. The resultant effects of the change in heart rhythms are not clearly known but major speculation suggests that it could lead to cardiac problems. Strong electromagnetic fields are also known to polarize the blood but the medical effects of these are still not understood.

Mitigation Measures:

(i) Ensure strict access controls to the electricity power lines; and

(ii) Enforce way leave requirements for power lines.

8) Uncontrolled access to the high current-carrying wires in the operations phase may lead to accidental electrocution of passer-bys especially in cases where cables have dropped and are still live.

Mitigation Measures:

(i) Ensure strict access controls to the electricity power lines; and

(ii) Enforce way leave requirements for power lines.

7.3.11 Socio-economic Impacts

Cultural diffusion and to some extent, extinction of some values and practices resulting from influence from diverse ethnic group and the planned and unplanned (spontaneous) immigration into the area.
The most notable negative socio-economic in sources of income for women in the project areas is that affecting the dolm palms which are sources of material for making mats and baskets for sale which has been a steady source of income on weekly basis. Other socio-economic pillars of the community that are likely to be lost are sand harvesting, reduction in livestock (cattle, sheep and goats), and sale of livestock manure (1.5 tonnes of manure selling for Kshs. 8,000 as of September, 2015).

There will also be social disruption/disorientation of community support programmes from donors within and without the project area.

**Mitigation Measure**

(i) Where possible, with the assistance of the Ministry of Gender, Sports, Culture and Social Services facilitate the promotion of cultural preservation and protection of rights of minorities and marginalized groups within the project area.

(ii) Promote planting of dolm palms in the areas earmarked for settlement.

(iii) Transfer the current community support programmes to the new settlement areas.

(iv) Promote distribution of social amenities and establishment of socio-economic structures that are in tandem with the new resettlement areas as part of the social corporate responsibility.
CHAPTER 8: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

8.1 General
Along with the potential impacts presented in this chapter, proposed mitigation measures have also been highlighted for appropriate action. Some impact mitigation has already been proactively addressed in the design, and legal and regulatory framework, while others would be undertaken through considered incorporation in the implementation of the project and guided by the environmental and social management plan (ESMP) developed under this report. The ESMP provides a general outlay of the activities, associated impacts, mitigation action plans and appropriate monitoring indicators. Implementation timeframes and responsibilities are also defined. It is however recommended that a detailed decommissioning audit be undertaken at the appropriate time.

8.2 Management Plan Principles
To realize the project goal, acceptability by a majority of the beneficiaries and minimal effects to the physical environment will require to be integrated in the project through constant consultation throughout the project coverage.

It is recommended that management guiding principles specific to this project be developed that will allow integration of environmental management considerations during the construction and operations. Among the basic areas that need to be considered in guiding management of this particular project implementation will include;

(i) Soil erosion control, prevention of siltation and discharge of pollutants into the water sources mainly from the seasonal rivers and streams,
(ii) Integration of environmental, social and economic functions into the project implementation,
(iii) Compensations or appropriate acquisition process of any land acquired and/or property affected by the projects is in accordance with the laid down guidelines,
(iv) The contractors and other players in the project activities be prevailed upon to implement the EMP through a sustained supervision and continuous consultations.

8.3 Specific Management Issues
8.3.1 Management Responsibilities
In order to implement the management plan, it is recommended that an expert is identified to oversee environment and management aspects including the dam conservation, soil erosion control and re-vegetation whenever appropriate. The expert would also be expected to co-ordinate and monitor environmental management during construction and post monitoring audits of the dam (as well
as the existing ones). Other responsibilities would go to respective County Environmental Officers, County Water Officers, County Planning Officers and the County governments among others who would oversee compliance in accordance with the law and this management plan.

The responsibility relationship is as follows;

(i) TARDA will be responsible for coordination activities and liaisons, particularly in regard to the water resources resource management, construction, quality control and social issues during the project implementation,

(ii) The County Water Offices in the project area will ensure that the contractor is observing all measures for protection of water resources,

(iii) TARDA will liaise with the County Environment Officers on matters of environmental and social nature. The stakeholder and riparian communities will be responsible of overseeing that the implementation of the environmental management plan established under this report and that there are no adverse impacts,

(iv) It would be recommended that the Community Liaison Officer at TARDA directly interact with the local communities on social, economic and cultural matters for long-term sustainability of the dam and associated components. In this regard, the Contractor will also be asked to establish a liaison person for ease of communication on concerns to the project management,

(v) The National Environmental Management Authority (NEMA) through the County Environment Offices in the project shall be responsible of surveillance of environmental and social aspects of the project implementation,

(vi) Water Resources Management Authority (WRMA), responsible of water resources management, will be responsible of streamlining water abstraction and use in the project area,

8.3.2 Environmental Management Guidelines

Upon completion and commissioning of the dam, it will be necessary to establish appropriate operational guidelines on environmental conservation and social linkages to enable TARDA identify critical environmental and social issues to institute appropriate actions towards minimizing associated conflicts. The guidelines should cover among other areas environmental management programmes, standard operation procedures, compliance monitoring schedule and environmental audit schedules as required by law. Social harmony of the dam and associated components will be achieved through collaboration with the stakeholders or community management committees introduce along administrative zone.
8.4 Environmental and Social Management Plan

The scope of this environmental management plan (ESMP) document is to give guidelines to all parties involved in construction, maintenance and utilization of the Dam in fulfillment of environmental and social requirements. The management plan has a long-term objective to ensure that:

(i) Environmental management conditions and requirements are implemented from the start of the project and post construction period, and

(ii) Precautions against Damage to environment and property and claims arising from Damages are compensated expeditiously.

The tables below therefore summaries the Environmental and Social Management Plan for this project. They describe the parameters that can be monitored, and suggests how monitoring should to be done, how frequently, and who should be responsible for monitoring and action.
### 8.4.1 Environmental and Social Management Plan for the Construction Phase

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<td>✓ Notify and sensitize all affected land owners before surveying their land, ✓ Involve the local administration and other social groups in social moderations</td>
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<td>− Land acquisition and compensation,</td>
<td>• Acquisition process of required land for the project construction and buffer zone as well as camp sites</td>
<td>✓ Undertake a comprehensive land acquisition and resettlement action plan (LAP &amp; RAP) as a basis for compensations, ✓ Compensate appropriately any land acquired for the main dam, evacuation power line corridor, access roads and the power house, buffer zones, water treatment plant, sand traps, the pipelines and storage tanks, ✓ Sensitize landowners on necessary land use changes for the protection of the dam.</td>
<td>TARDA Local Administration</td>
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<td>• Negotiating with land owners on compensation of land and development</td>
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<td>− Dam Catchment delineation</td>
<td>• Potential social conflicts</td>
<td>✓ Collaborate with the local leadership to avert social conflict</td>
<td>TARDA Contractor</td>
<td></td>
</tr>
<tr>
<td><strong>Site clearing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>− Vegetation removal</td>
<td>• Riverine vegetation removal, ✓ Confine vegetation removal to the surveyed necessary project area only, ✓ Plan for vegetated buffer zones with suitable indigenous tree species around the dam and along the banks of the rivers,</td>
<td>Contractor</td>
<td>Initial construction period</td>
<td></td>
</tr>
<tr>
<td>− Biodiversity loss</td>
<td>• Damage to related aquatic biodiversity,</td>
<td></td>
<td>No direct cost implications</td>
<td></td>
</tr>
<tr>
<td>− Access to the river</td>
<td>• Disruption of existing access to the</td>
<td>✓ Provide for approved direct access</td>
<td>Contractor</td>
<td></td>
</tr>
<tr>
<td>Project Activities</td>
<td>Environmental and Social Issues</td>
<td>Management Action Plans</td>
<td>Responsibilities</td>
<td>Monitoring Timeframe and Cost Estimates</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
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<td>-----------------------------------------</td>
</tr>
<tr>
<td>and livestock watering point</td>
<td>river by the residents, • Blockage of livestock watering and mineral eating locations</td>
<td>to the river upstream and downstream of the dam, • Allow landowners disposal of trees and other vegetation on their land through controlled commercial charcoal burning and charcoal briquette making, • Removal for offsite disposal all plant matter and organic residual for future water quality safety</td>
<td></td>
<td>Action immediately upon commencement of works</td>
</tr>
<tr>
<td>Site clearing</td>
<td>• Pollution of water from human waste residuals, • Pollution at waste disposal sites • Cultural aspects of graves relocation, • Future effects to water quality from manure and biomass residuals</td>
<td>• Undertake a controlled and supervised decommissioning of pit latrines (current and abandoned) on the affected settlement locations, • Undertake a procedural relocation of all identifiable graves to locations pre-agreed and identified by each of the relevant families, • Allow the landowners to dispose of manure from cattle pens at market rates,</td>
<td>Contractor</td>
<td>No direct costs (Part of the construction costs)</td>
</tr>
<tr>
<td>– Removal of houses, sanitary facilities and cattle pens,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Relocation of graves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Works and related components</td>
<td>• Siltation of river downstream of the dam, • Lubricants and oil spills from construction machinery, • Spoil materials disposal.</td>
<td>• Provide barriers or other measures to prevent discharge of silt downstream Tana river, • Any oil spills from machines to be contained for safe disposal, • Construction to stick to the schedule or shorter period</td>
<td>Contractor</td>
<td>During the construction period</td>
</tr>
<tr>
<td>– Earth moving</td>
<td></td>
<td></td>
<td></td>
<td>No direct cost estimate on this item</td>
</tr>
<tr>
<td>Construction Works and related components</td>
<td>• Possible intrusion to the local communities private life by foreign contractors, • Migration into the project area</td>
<td>• Provide an awareness and sensitization forum for the workers as well as the neighbouring communities, especially on communicable social infections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Activities</td>
<td>Environmental and Social Issues</td>
<td>Management Action Plans</td>
<td>Responsibilities</td>
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</tr>
<tr>
<td></td>
<td>(from within project sub-county and other parts of the country). • Potential social diseases transmissions including HIV and AIDS</td>
<td>such as HIV/AIDS, TB, etc., ✓ Sensitize the communities on co-existence with foreign workers.</td>
<td>Contractor, TARDA, Public Health Officer to guide</td>
<td>Attention on this throughout the construction period</td>
</tr>
<tr>
<td>Health and safety of workers and communities</td>
<td>• Safety of the workers and adjacent communities • Noise and vibrations from construction machinery • Negative social interactions (cultural interference, immorality, etc.,)</td>
<td>✓ Provide workers with appropriate personal protective gear and enforce application of the same at all times while at work ✓ Provide appropriate sanitation facilities and waste holding bins at the workers camps and other project areas ✓ Involve local labour to the extent possible on the project construction activities.</td>
<td></td>
<td>~KShs. 500,000 for public education and awareness,</td>
</tr>
<tr>
<td>Construction Works and related components</td>
<td>• Dust emissions and depositions into settlements and cultivated land, • Emissions from construction machinery into the atmosphere, • Waste discharges from construction camp sites • Material sites management.</td>
<td>✓ Maintain all construction equipment in good operating conditions to reduce noise and emissions, ✓ Earth moving and excavations be under damp conditions. Dry dusty materials be stored covered, ✓ Material sites are fenced up for the safety of the neighbouring communities.</td>
<td></td>
<td>~KShs. 2M for HIV/AIDS and other communicable diseases control campaigns</td>
</tr>
</tbody>
</table>
### 8.4.2 Environmental and Social Management Plan for the Operation Phase

<table>
<thead>
<tr>
<th>Project Activities</th>
<th>Environmental and Social Issues</th>
<th>Management Action Plans</th>
<th>Responsibilities</th>
<th>Monitoring Timeframe and Cost Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam Operations</td>
<td>Wastage of water especially if irrigation is allowed</td>
<td>Encourage residents to give priority to domestic and livestock for sustainable utilization of available water,</td>
<td>TARDA to liaise with WRMA to streamline water abstraction and use Sub-county Agricultural Officer to guide on sustainable irrigation</td>
<td>A continuous activity</td>
</tr>
<tr>
<td>Safety risks at and downstream the dam</td>
<td>• Injuries of the operators and visitors, Safety risks of a dam break to downstream installations aquatic ecosystems, social and economic features. • Risks of drowning into the dam to children, the aged and livestock • Potential safety risks from wildlife (hippos, crocodiles and snakes) • Safety Risks Assessment of the cascade system</td>
<td>Undertake a safety risk assessment of project and safety audit of the entire cascade system as a whole and develop emergency response strategy, Maintain a fence around the dam with provision for limited and/or controlled access to the dam water, Enhance close surveillance for the community, especially those living on risk prone areas, Sensitize the communities on dam safety issues associated with the dam, particularly in relation to settlements and institutional siting, Provide safe water access points for the communities.</td>
<td>TARDA, Public Health, OHS Officer</td>
<td>Continuous attention ~O&amp;M Cost for safety and emergency preparedness</td>
</tr>
<tr>
<td>Project Activities</td>
<td>Environmental and Social Issues</td>
<td>Management Action Plans</td>
<td>Responsibilities</td>
<td>Monitoring Timeframe and Cost Estimates</td>
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</tr>
<tr>
<td><strong>Dam Operations</strong></td>
<td>• Base Environmental flow must always be allowed downstream the dam, • Illegal water abstraction alongside the dam and wastage of water (especially if exposed for irrigation), • Sand harvesting from the dam area and upstream, • Tree harvesting in the buffering zone • Access to biodiversity resources in the area</td>
<td>✓ Water abstraction for irrigation should be as permitted by ERMA ✓ Sand harvesting to take place from authorized locations only (e.g. sand interception dams on the dam catchment area), ✓ Identify social linkages and collaborations with respect to water use through the CSR policy ✓ Collaborate with WRMA and Ministry of Agriculture to facilitate easy and safe access to irrigation water by the local communities</td>
<td>TARDA NEMA WRMA</td>
<td>Continuous attention ~KShs. 0.5M per year for surveillance activities</td>
</tr>
<tr>
<td><strong>Dam Operations</strong></td>
<td>• Contamination of water from the catchment and illegal direct access to the dam, • Vector breeding (mosquitoes, etc.), • Pollution discharging from settlements, operators quarters and markets into the dam,</td>
<td>✓ Participate in the vector breeding control (mosquitoes, etc.), ✓ Participate in sensitizing the communities on protecting the water sources from pollution sources, ✓ Participate in advising the communities on the need to boil or disinfect the water before use if obtained directly from the dam.</td>
<td>TARDA, Public Health Department, Community Leadership</td>
<td>A continuous activity</td>
</tr>
<tr>
<td><strong>Dam Operations</strong></td>
<td>• Non-compliance with water abstraction regulations, • Natural Resources Utilization, • Water use linkages among the communities,</td>
<td>✓ Comply to the provisions of the Water Resources Management Authority, ✓ Assist in organizing communities for effective and sustainable utilization of natural resources associated with the dam, e.g. wildlife. ✓ Establish appropriate water user associations in the areas neighbouring the dam to WRMA to give guidance on water abstractions TARDA to cooperate with NEMA on guidance</td>
<td></td>
<td>Initiate action upon commencement of construction and enhance during operations ~O&amp;M Cost for institutional strengthening (Could vary annually)</td>
</tr>
</tbody>
</table>
### Project Activities
- Collaborated sharing of the water resource,
- Establish a specific monitoring system for the dam and its water catchments.

### Environmental and Social Issues
- **Pollution control,**
- **Runoff interception efficiency,**
- **Soil erosion control**
- Effects of changing land use practices,
- Enhanced vegetation removal in the catchment,
- Influenced sanitation trends in the neighbouring homesteads

### Management Action Plans
- Encourage immediate landowners to take responsibilities of the dam safety,
- Immediate landowners to be motivated into maintaining buffer zones along the river banks and the dam itself,
- Consider participating in the global Tana River Catchment Management and influencing change in land use practices.
- Provide additional sand traps where appropriate.

### Responsibilities
- TARDA
- NEMA
- WRMA

### Monitoring Timeframe and Cost Estimates
- A continuous activity
- No immediate cost estimate
8.4.3 Environmental and Social Management Plan for the Decommissioning Phase

<table>
<thead>
<tr>
<th>Project Activities</th>
<th>Environmental and Social Issues</th>
<th>Management Action Plans</th>
<th>Responsibilities</th>
<th>Monitoring Timeframe and Cost Estimates</th>
</tr>
</thead>
</table>
| **Decommissioning Phase** | • Removal of construction sites (housing, toilets, waste dumps, etc.),  
| | • Removal of construction residual material holding sites,  
| | • Effects of material borrow pits left open  
| | • Disposal effects of wastes and debris | ✓ The contractor to prepare a decommissioning plan of all construction installations and associated sited at least 3 months prior to end of construction. | TARDA, Ministry of Energy & Petroleum, NEMA, WRMA | During construction  
| | • Removal of part or all of the power generation plant  
| | • Demolition of the dam structure,  
| | • Removal of the power transmission line | ✓ Notify NEMA at least one year before the intention to decommission  
| | | ✓ Undertake a decommissioning audit at least six months before the activity and provide a decommissioning plan,  
| | | ✓ Undertake the decommissioning process following the decommissioning plan and under supervision by NEMA,  
| | | ✓ Rehabilitate the affected locations to the satisfaction of NEMA and other stakeholders. | | At decommissioning stage and surveillance thereafter  
| | | | No direct costs |
CHAPTER 9: ENVIRONMENTAL AND SOCIAL MONITORING PLAN

9.1 Monitoring Parameters
The environmental and social monitoring will involve a continuous surveillance of performance of specific functions during the construction and operation phases of the project. Among the aspects to be monitored will include the following;

9.1.1 Construction
(i) Health and Safety particularly of the construction workers and the neighbouring communities,
(ii) Social linkages and interactions with the construction works,
(iii) Interaction with key sensitive environmental features including hydrology, aquatic life forms, soil erosion, vegetation loss, air quality, etc.,

9.1.2 Operations
(i) Safety aspects of the dam,
(ii) Downstream hydrology
(iii) Biodiversity development,
(iv) Land use trends,
(v) Economic features.

9.2 Monitoring Schedule

Table 11: Monitoring Plan

<table>
<thead>
<tr>
<th>Environmental/Social Aspect</th>
<th>Monitoring Indicators</th>
<th>Frequency</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental pollution</td>
<td>Air quality</td>
<td>Continuous visual observation, Measurements quarterly</td>
<td>✓ Mainly dust from earth moving and emissions from the equipment</td>
</tr>
<tr>
<td>during construction (Air, Noise, Water, etc.)</td>
<td>Noise and vibrations</td>
<td>Continuous surveillance Measurements on quarterly</td>
<td>✓ Controlled from equipment</td>
</tr>
<tr>
<td>Water quality</td>
<td>Once a month</td>
<td>✓ Mainly downstream sediment levels</td>
<td></td>
</tr>
<tr>
<td>Soil loss</td>
<td>Continuous surveillance</td>
<td>✓ Extent of erosion in the immediate catchment</td>
<td></td>
</tr>
<tr>
<td>Ecological disruption</td>
<td>Vegetation types lost</td>
<td>Quarterly during driving construction period</td>
<td>✓ This will provide the nature of plants species for compensation purposes</td>
</tr>
<tr>
<td>Animal species and loss of habitats (fish, crocodiles, hippos, etc.)</td>
<td>Initial and quarterly through the construction period</td>
<td>✓ Specific habitats need to be marked before construction</td>
<td></td>
</tr>
<tr>
<td>Social disruption</td>
<td>Loss of farm lands</td>
<td>Pre-construction</td>
<td>✓</td>
</tr>
<tr>
<td>Environmental/Social Aspect</td>
<td>Monitoring Indicators</td>
<td>Frequency</td>
<td>Remark</td>
</tr>
<tr>
<td>-----------------------------</td>
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</tr>
</tbody>
</table>
| Compensation and relocation | Pre-construction activity  
Review at construction commencement  
Review at commissioning stage | ✓ It would be expected all compensation and relocations are completed before construction is commenced |
| Alternatives to institutions lost (schools, health centres, markets, etc.) | Before commencement of works | ✓ This aspect to be addressed alongside the resettlement process |
| Acceptance at host areas for displaced persons and adaptability | Before construction period | ✓ Constitutes part of the resettlement process  
✓ Important to track potential social conflicts |

**✓ Commissioning**

| Waste disposal | Debris at points of construction  
Successful decommissioning of construction camps | Upon completion of works  
Upon completion of works | ✓ It is a onetime assessment  
✓ Site rehabilitation and evaluation will be necessary |

**✓ Operations**

| Environmental pollution (air, noise, water quality and flows) | Air quality | Half yearly sampling | ✓ Dust emissions, emissions from equipment. |
| No noise and vibrations | Half yearly | ✓ Machine operations (mainly localized) |
| Water quality | Half yearly measurements | ✓ Upstream and downstream the plant |
| Ecological trends | Invasive weeds | Annual survey (speciation) | ✓ This will identify new species and provide mitigation measures |
| Wildlife habitats and breeding areas | Annual survey (speciation and counts) | ✓ Continuous opportunities to be established |
| Evolving habitats and species dynamics  
Influencing factors | Annually initially then every 3 years | ✓ New aquatic conditions expected to evolve gradually |
<p>| Hydrology | Flows in the main river stream | Monthly (or during heavy rains) | ✓ River gauging stations to be installed upstream and downstream of the dam |
| Sediment transportation | Annual measurements at dam entry | ✓ This task is necessary for the dam and the upstream of the river and tributaries |
| Dam capacity | Every 2 years | ✓ Necessary in water |</p>
<table>
<thead>
<tr>
<th>Environmental/Social Aspect</th>
<th>Monitoring Indicators</th>
<th>Frequency</th>
<th>Remark</th>
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</thead>
<tbody>
<tr>
<td>variations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety from potential dam break</td>
<td>Safety risks to immediate residents and their livestock</td>
<td>Safety risk audit every 3 years</td>
<td>✓ Safety audits is an integral part of the entire project</td>
</tr>
<tr>
<td></td>
<td>Safety risks to downstream residents</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potential features at risks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>Security and safety</td>
<td>Quarterly</td>
<td>✓ Involvement of the stakeholders and local communities would be necessary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓ Safety of residents from wildlife and risks of drowning</td>
</tr>
<tr>
<td></td>
<td>Access to water (domestic and irrigation)</td>
<td>Half yearly</td>
<td>✓ Safety of residents from wildlife while accessing water</td>
</tr>
<tr>
<td></td>
<td>Land use changes</td>
<td>Annual surveys initially then every 3 years</td>
<td>✓ An important determinant of social trends</td>
</tr>
<tr>
<td></td>
<td>Cultural trends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic trends</td>
<td>Value of dam to residents (support to livelihoods, fishing, tourism, irrigation, etc.)</td>
<td>Half yearly</td>
<td>✓ This is an important factor on the CSR front.</td>
</tr>
</tbody>
</table>
10.1 Conclusions
The primary objective of the High Grand Falls Project is to provide a large-Scale Multi-Purpose Water Reservoir catering for Public water Supply, Irrigation, River Regulation, Flood Control and Power Generation in order to effectively contribute to the regional and national social-economic development. Though the project there is acceptability and goodwill from the community living in the project area, there are significant environmental and social issues associated with the construction and operation of the proposed project. To that end, mitigation measures have been integrated in the components of the environmental management plan (EMP) in this report for consideration in the final design, construction and maintenance of the Dam.

The EIA and preparation of this Study Report was carried out to fulfil legal requirements, as outlined in the Environmental Management and Co-ordination Act (1999), and the Environmental (Impact Assessment and Audit) Regulations (2003). Recommendations for corrective measures for the potentially significant and/or adverse environmental impacts and safety risks have been provided as an integral part of this EIA report.

Rigorous implementation of the Environmental Management and Monitoring Plan will facilitate the mitigation and/or prevention of potentially adverse environmental impacts.

Diligence on the part of the Contractor and proper supervision by the Proponent will be crucial for ensuring success of the EMP and for ensuring that the recommended measures are implemented throughout the design, construction and operational phases in order to avert any negative impacts.

10.2 Recommendations
A summary of the recommendations for the prevention and mitigation of potentially adverse environmental and socio-economic impacts are stated below:

(i) The proponent to implement the mitigation guideline provided in the environmental management plan;

(ii) The RAP report of 2009 has been overtaken by events and hence the need for a review to update the list of project affected persons and cost estimates for the compensation and resettlement;

(iii) Ensure that the families that are to be displaced by the project are resettled and assisted to regain their former livelihoods, or equivalent, in a reasonable period of time.

(iv) Construction works in the planned project be carried out in accordance with approved designs, regulations, policies and laws;
(v) The Proponent should ensure rehabilitation of all sites that may be used for construction activities such as camps, sites for storage materials and any paths, tracks that may be established during the construction phase is done;

(vi) The Proponent should ensure compensation of the persons who will be displaced by proposed project

(vii) The Operation and Maintenance of the proposed HGF Dam Project to comply with the best management practices and the principles of environmental management including the principles of sustainability, intergenerational equity, prevention, precaution and polluter pays

(viii) Ensure the sentiments expressed by the community under this report are integrated in the implemented plan of the project, especially where aspects of social interest are concerned;

(ix) Institute effective communication, education and awareness towards the project beneficiaries for enhanced acceptability and social harmony;

(x) The proponent to undertake Environmental Impact Assessment Studies for all the proposed borrow areas of construction materials

(xi) A complete audit be undertaken and submitted to NEMA a year after the project is commissioned to ensure that all the proposed mitigation measures have been complied with.

Overall, considering the proposed location, construction, management, mitigation and monitoring plan that will be put in place and the importance of this Dam, the development of this project is considered strategic and beneficial and should therefore be allowed to proceed.
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<table>
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<tr>
<th>Annex</th>
<th>Description</th>
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<tbody>
<tr>
<td>Annex I:</td>
<td>Topographical Map of HGF Dam</td>
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<tr>
<td>Annex II:</td>
<td>Layout Plan of HGF Dam</td>
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<td>Annex III:</td>
<td>Project Implementation Schedule</td>
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<td>List of Persons Consulted</td>
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<tr>
<td>Annex VIII</td>
<td>NEMA license of Firm of Experts</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
</table>

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Annex V: Minutes of Consultative Public Consultations
Annex VI: Public Participation Sample Comments
Annex VII: Pictorial Presentations
The Kabuuaka Water Falls along Tana River as it approaches the arid lands of Tharaka

River Gauging Station (RGS) downstream of the Kabuuaka Water Falls

Convergence of tributary with the Tana River at Usueni, Kitui

Riverine trees along a river laga in Tharaka

An access road at the project area

Vegetation at the project area
An acacia tree with many birds nests in Tharaka

Dome Palms that are a source of materials for making mats, trays and baskets in Tharaka

Children busy fetching water and making mats in Tharaka

Women busy weaving mats under a tree in Tharaka.

A woman transporting mats to the market in Tharaka

Girls and boys taking mats and chicken to the market in Tharaka.
Consultancy Team and TARDA Officials at Kabuuka Water Falls along Tana River in Tharaka

Consultancy team and TARDA officials at the Office of the DCC in Marimanthi-Tharaka

Kick-off meeting at the DC’s office Marimanthi

Meeting with sub-county staff at the acting County commissioners office

Focus Group discussions with Chiakariga community, leaders and opinion leaders

Focus Group discussions with Chiakariga community, leaders and opinion leaders
Chiakarika leaders group discussions

Group leader making a presentation during the meeting

The local Tharaka community at a consultative meeting in Tharaka

Meeting with Kamanyaki community