ENVIROMENTAL & SOCIAL IMPACT ASSESSMENT REPORT

REHABILITATION OF 30Kw YANDOHUN MICRO-HYDRO POWER PLANT, LOFA COUNTY-LIBERIA

SUBMITTED TO:
ENVIRONMENTAL PROTECTION AGENCY OF LIBERIA
3RD STREET, SINKOR
MONROVIA, LIBERIA

July 2, 2010

PREPARED FOR:
Government of Liberia, Rural & Renewable Energy Agency (RREA)
In Partnership with the World Bank

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“Turning Africa Green”
ACKNOWLEDGEMENT

The Consultant wish to acknowledge that a number of relevant sources have contributed greatly to the information included in this report. Some of these sources include information received from the client, previous report prepared by environmental consultancy company, interactions and briefing with a number of stakeholders both in the private sector and government institutions, the local county authority and interested and affected persons of the immediate project area and its surrounding.

Materials which have been used as resource guide include:


The extracted Information obtained from the above materials has been used without or with only minimum editorial alteration. The Consultant absolutely has no intent of representing that information as his own work. He has had to rely, however, on the accuracy of the information provided by sources other than his own.

Tribute is also paid to all members of the team who participated in the environmental site assessment, compilation of field data and involvement in the completion of the final report, and all those who contributed significantly either by giving their expert opinion, peer review and critique of the document.

To the entire above, the Consultant makes professional recognition and grateful appreciation and acknowledgement. The compilation of information and the resulting interpretation on environmental aspects of the project remains, however, the responsibility of the Consultant.
LIST OF ACRONYMS

CCRF: Conduct for Responsible Fisheries
DOE: Department of Energy
EA: Executing Agency
ECOWAS: Economic Community of West African States
EEZ: Exclusive Economic Zone
EHS: Environmental Health and Safety
EIS: Environmental Impact Statement
ELBC: Eternal Love Broadcasting Corporation
EMO: Environmental Management Office
EPA: Environmental Protection Agency of Liberia
EPAL: Environmental Protection Agency of Liberia
EPC: Engineering Procurement & Construction
ERB: Energy Regulatory Board
ESIA: Environmental & Social Impact Assessment
ESMP: Environmental and Social Management Plan
ESMU: Environmental Social Management Unit
FDA: Forestry Development Authority
GDP: Gross Domestic Product
GIIP: Good International Industry Practice
GOL: Government of Liberia
I&APs: Interested & Affected Persons
IA: Implementing Agency
INGO: International None Governmental Organization
IUCN: Nature
KW: Kilo Watt
LEC: Liberia Electricity Corporation
MCS: Monitoring, Control and Surveillance
MDG: Millennium Development Goal
MLME: Ministry of Lands, Mines and Energy
MSF: Medicine San Frontier
NEP: National Energy Policy
NGO: None Governmental Organization
NOI: Notice of Intent
NTFP: None Timber Forest Product
PRS: Poverty Reduction Strategy
PVC: Poly Vinyl Chloride
RREA: Rural and Renewable Energy Agency
TOR: Terms of Reference
UNCED: United Nations Conference on Environment & Development
UNMIL: United Nations Mission in Liberia
USAID: United States Agency for International Development
WAPP: West African Power Pool
YHPM: Yandohun Hydro Power Management
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CHAPTER 1.0: EXECUTIVE SUMMARY
1.0.1 Background Information

Between 1990 and 2005, Liberia has been faced with instability and severe decline in infrastructure, social services and employment. President Ellen Johnson Sirleaf, Africa’s first female President, took office in mid-January 2006 facing severe challenges. Fourteen years of civil war had destroyed much of Liberia’s physical and human capital and severely damaged its institutions. The new government has supported programs to improve governance, build capacity, and manage post conflict recovery. Although much has been achieved, the government still faces numerous challenges. Per capita GDP was estimated at US$195 in 2007, still below prewar levels, ranking Liberia among the poorest countries in the world. According to the nation’s Poverty Reduction Strategy (PRS), 64% of the population lives below the poverty line, and about 48% live below the extreme poverty line. Of these, 73% reside in rural areas. In order to improve these conditions, GOL is determined to create jobs and opportunities that would improve the condition of the people in support of its poverty reduction strategy.

The rehabilitation of the proposed Yandohun micro managed hydro power plant is an approach by the Liberian Government to improve the living standard of the rural communities and provide them basic social services. This Project is an initiative by the Liberian Government implemented by the Rural and Renewable Energy Agency with support and partnership from the World Bank.

1.1 Project Description

The proposed project calls for the rehabilitation of the Yandohun micro-hydropower station on the Yando River. Prior to the war this station provided electricity for hundreds of residents in the rural community of Yandohun. Upon rehabilitation the previous 30kw station will be upgraded to 60kw with transmission lines, distribution lines and existing poles to support 3 communities including Yandohun. The key features of the Project that will be rehabilitated include a tiny dam, an underground water conveyance system and a power station.

**Existing Dam**

**Existing Forebay Tank**
The hydro station will be supplied through a built forebay tank(reservoir). The water from the hydro station reservoir will be diverted, via a headrace tunnel and an underground penstock, to a power station located about 100-150m below the steep slope and also overlooking the abandoned forebay tank. A power house building with machine floor area, control room and office room will be constructed to house the power turbine.

The power generated output is expected to be an electro-mechanical governor with microprocessor control and ballast load (water cooled) of 60kW. A 400v, 50Hz, 0.8 pf. 3 phase generator voltage will be required to run the Francis turbine with a rated discharge of 260 Lit/S. The power house will have a mini generator to serve as a stand by generator.

1.2 Impacts Associated with the Project and Mitigation Measures

The potential environmental impacts associated with the project have been categorized into two set: impacts during the construction phase and impacts during the operational phase. The construction impacts are likely the most significant and even these are minor. It is required that the construction contractor prepare his own Environmental and Social Management Plan (CESMP), based on the present ESMP and the World Bank Group General Environmental, Health and Safety Guidelines (WBG EHS) and the WBG EHS Guidelines on Electric Transmission and Distribution. The contractor shall be responsible for the implementation of the CESMP, which will be monitored by the Supervising Engineer and the Environmental and Social Management Unit (ESMU) of the RREA (Rural & Renewable Energy Agency).
1.2.1 Air

The construction activity will generate airborne dust as well as NOx, SOx and particulate matter. These will be as a result of equipment the operation of construction machinery and road construction. This impact will be limited and localized.

The project construction will also give rise to particulate dust which will lead to impacts on crops, animals, villages and houses located near the project. To mitigate these impact service roads should be sprayed and trucks conveying materials should be covered.

1.2.2 Noise

Construction noise due to machinery and equipment operation and construction activities will generate noise between 80 to 95 dBA at a distance of 15 m which is higher than the tolerable threshold of 72dBA. This impact will be low since the area is not populated.

During the operation, noise generation will be restricted to the power plant operation. Noise reduction measures will be put in place to protect workers.

1.2.3 Soil

Impact to soil during construction will be due to the following: (i) loss of topsoil, (ii) failure to refill and re-vegetate borrow areas and temporarily used land, (iii) erosion, (iv) soil contamination by products used for the Project, and (v) failure to re-utilize displaced earth during the construction period. These will be mitigated by: i) allowing immediate revegetation for keeping soil in place) of slopes to minimize erosion, (ii) use of top soil removed and stockpiled from Project areas, (iii) installation of sediment runoff control devices, (iv) erosion and revegetation success monitoring (iv) installing oil separators at wash down and refueling areas, and by installing secondary containment at fuel storage sites

1.2.4 Water

Potential impacts to water during the construction will be due to the following:

(i) Erosion due to road building, construction work in the dam area, soil deposits, and accidental water releases (ii) Sedimentation in the slow flowing river stretches, with shallowing of deep pools (iii) Sanitary effluents from the construction worker’s in the area (iv) potential drying up of a small part of the river downstream during filling the forebay tank (v) Oil spills.

Erosion impacts will be mitigated by putting in place erosion abatement measures at all construction sites. Roadsides and other areas with denuded soils should be sowed by grass, road drainage should be strengthened with appropriate concrete/stone settings, machine parking areas and roads should be compressed with laterite to the extent possible, etc.
In order to mitigate impacts associated with spillage the machine parking area, the workshop area, and the fuel and oil filling area should be gathered to one area that should be paved, and equipped with a controllable drainage so that all diffuse spills and accidental spills could be collected at all times. Sanitary effluents will be controlled by preventing discharge into the river, which could cause health hazards for those living downstream. In no case will the river downstream be allowed to dry up. A minimal of 10% of total water flow should be maintained initially during the operational period. Following some sample monitoring of aquatic life, especially fish species, and water quality this figure could be adapted. It is roughly estimated that during the dry season, water flow could decrease as low as 0.050m$^3$/s, especially in February. In this regard, the existing outlet in the dam area, shown below, that allows water flow to downstream stretches should be monitored to prevent obstruction so that water flow downstream can be maintained at all times.

1.2.5 Aquatic Ecology

The obstruction of regular flow of water in the area of the river between the dam and the discharge point of the power house will alter the habitat conditions of fishes within the area, especially during the dry season. This could affect fish productivity and the well being of animals in this area.

To address this condition water flow must always be maintained within this zone. This could mean rationalizing the operation of the power house during the dry season when river flow is low. A monitoring program should be launched in the operational phase, two times per year, once at the end of rainy season and once at the end of the dry season, when water quality is likely to be worst.

1.2.6 Terrestrial Ecology

Anthropogenic activities associated with slash and burn farming methods have already impacted the fauna and flora conditions of the project area, in addition to the previous construction activities of the power plant. The proposed rehabilitation could further intensify this condition. Rehabilitation of access roads could increase access to the area and intensify harvesting activities. The clearing of vegetation for the rehabilitation of project infrastructure could also
further fragment the area and make it vulnerable. Mitigation would be required for the revegetation of the area and actions taken for protection of the project area and its forest resources from unsustainable activities such as hunting, timber harvesting, land clearing etc.

The terrestrial ecology of the area is not unique as the fauna and floral species existing in the area are common in the surrounding areas. Mitigation measures would need to be followed to minimize these impacts and ensure the protection of terrestrial resources.

1.2.7 Socio-economic Project Impacts and Mitigation Measures

1.2.7.1 .Benefits

The project would provide electric power for more than 200 households and reduce household expenditure on current energy supplies such as kerosene, flashlight and candle. The project will provide boost to the establishment of small businesses such as video clubs, cell phone charging booths, general merchandise etc. The establishments of agro processing and storage facilities, food preservation in the medium to long term will also serve as a major boost to poverty reduction and food security.

1.2.7.2 Payment of service Fees

Because of the need to sustain the project, service users will be required to pay fees. Currently, residents spend between LD50-LD310 monthly on energy supplies for lighting at night. At present there is no clear understanding on what the fees will look like. This has been responsible for the anxiety amongst some of the residents in the project communities. However, more than 90% of those surveyed expressed their willingness to pay service fees between LD$10.00 to LD$100.00 for the supply of power.

The project is not likely to have impact on cultural and archaeological resources given that these are not located within project areas

1.2.7.3 Tourism

When the project becomes operational, it could attract visitors to the area who may expect and demand NTFPs and wildlife meat. This demand is, however, expected to be low.

1.2.8 Occupational Health and Safety Impacts of Power Transmission and Distribution

The construction, operation, maintenance and decommissioning phases of the project will create occupational, health and safety issues that include exposure to physical hazards from use of equipment; trip and fall hazards, exposure to dust and noise, falling objects; work in confined spaces; exposure to hazard materials; and exposure to electrical hazard from the use of tools and machinery. Potential occupational health and safety hazards associated with power transmission
and distribution in this project include: live power lines, working at height, electric and magnetic fields. Mitigation measures would need to be followed to address these impacts.

1.3 Community Health and Safety

The health and safety of the project community is important to the success of the project. Potential community health and safety impacts associated with the construction and decommissioning of transmission and distribution power lines at the project include dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of migrants. The operation of live power distribution lines and substations may generate the additional impacts: Electrocution, Electromagnetic Interference, Visual Intrusion, Noise and Ozone. Mitigation measures would have to be followed to address these impacts.

Monitoring should be executed as part of an occupational health and safety monitoring program. The project should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents.

1.4 Resettlement

The rehabilitation of distribution and transmission lines will have no direct potential impact on farms and houses within the project area since there are no settlements around the proposed project site or people using the areas directly affected by the project site. Hence, there will be no resettlement under the current project plan.

1.5 Public Participation

Adequate information was given to the public about this project. A notice of intent was published in the local dailies and posted in the project communities. Town hall meetings were held in all of the project villages wherein community residents demonstrated full support and endorsement of the project, the only sticky issue of concern for community residents that needs to be resolved is the actual fees that residents would be required to pay for power supply. Notably, more than 90% of the residents are willing to pay some fees. Government institutions consulted on the project include Local Authority (Superintendent of Lofa County); Environmental Protection Agency; Ministry of Lands, Mines & Energy and the Rural and Renewable Energy Agency. Other members of the public also provided input during the public consultation period.

1.6 Budget for environmental/social mitigation and monitoring

In order to support the mitigation and social monitoring programs included in this report an estimated budget of US$42,240 has been recommended. This includes cost for monitoring the water, social
economic and environmental and social safeguards. Costs for ordinary mitigation measures directly linked to the construction activity, such as erosion control measures at construction sites and access roads, are not included in the budget. These costs should be included in the construction costs.
CHAPTER 2.0: GENERAL INTRODUCTION-AN OVERVIEW OF THE PROJECT

2.1.0 Objective and Scope of the Environmental Impact Assessment

The general objectives which have been set aside for the conduct of this Environmental and Socio Impact Assessment are:

- To establish the level of effect of the project operations on air and water quality (water used for drinking and agriculture purposes if any).
- To provide recommendation that will enable the institutions operate in a manner that will cause minimum damage/effect on air, and water quality (water use for drinking) and the forest ecosystem.
- To recommend that environmental and social considerations are explicitly addressed and incorporated into the development decision making process.
- To advance recommendation that would protect the productivity and capacity of natural systems
- To advance recommendations that would optimize resource use while at the same time giving consideration for the protection of surrounding resources in enhancing development.

The Government of Liberia through the Rural and Renewal Energy Agency has committed herself to conform to all of the guidelines and policies of the EPA for the operation and management of the proposed Yandohun micro-hydro project located in Yandohun, Lofa County.

In order to achieve this effort, and to realize a successful project, and achieve sustainable practice RREA hopes to pursue these outputs in its operations:

**Output 1:** To enhance socio-economic development in the rural project communities by developing sustainable and affordable hydro electricity. This will promote GOL Poverty Reduction Strategy and improve the livelihood of dwellers in the project area.

**Output 2:** To eventually turn over the project to the community in order to be micro managed by the surrounding communities which will see the community as owners and this will ensure the protection of the forest ecosystem, the environment, and conservation of the Biodiversity

**Output 3:** Prioritize the communities’ well-being and occupational health and safety, through occupational health and safety policy and management system.

RREA, apart from these outputs, has also committed herself to the below:

- To optimize measures that are necessary for the prevention of any adverse impact on the environment during its operations at all times;
- To ensure compliance with national and international legislations and guidelines on environmental health and safety;
• To ensure that all its operations are performed in compliance with the existing safety standards and labor and environmental protection rules.
• To ensure a pro-active involvement of workers associated with the project in environmental and occupational safety activities.
• Education and awareness will be a key activity in achieving this objective.
• Demonstrate the credibility of RREA and its commitment to ensuring that the relevant environmental studies required by the EPA are properly completed by a qualified Consultant certified by the EPA of Liberia;
• Convince all stakeholders, especially local residences, land owners, and environmental NGOs (local or international), that the RREA is a responsible Government institution which seeks to conform with international best practices;
• Provide all stakeholders with essential tools to facilitate regulatory compliance and improve operations, safety and environmental performance;
• Improve resource conservation and pollution prevention.

The Environmental and socio impact assessment (ESIA) for Yandohun Micro managed- Hydro Project is focused on the town of Yandohun and the surrounding towns of Dangalahun 1 and Dangalahun 2 in Kolahun District, Lofa County. The direct impacted area of the project covers around three acres of stretched land. The ESIA which covered strategic towns received inputs and concerns from inhabitants of more 3 villages.

2.1.1 Equipment & facilities for the project

The one week environmental and socio impact assessment covered parameters which utilize a number of environmental equipment and the completion of this report: among these is multi-perimeter water quality monitor, Noise Quality Monitor, Global Positioning Satellite, ARC GIS, compass, binocular, mobile weather station, etc.

2.1.2 Detail Description of methodology

Methodology I: Site reconnaissance

A number of questions and information obtained from the project site and about the project development were covered under this methodology.

II, Methodology II: Site Investigation

This step took into consideration the conduct of a site investigation and assessment. The conduct of these investigations provided detail descriptions about the physical nature of the project. The investigations cover the following:
• Description of the proposed project
• Description of the main processes
• A work program for the operation phase
• Location of the project (maps and photographs showing the location of the project relative to surrounding physical, natural and man-made features, existing land-uses on and adjacent the project site.

The investigations also did a comprehensive coverage of the likely impacts of the project. The following were considered:

• Impacts on people, human health, fauna and flora, soils, land use, material assets, water quality, and hydrology, air quality, climate, noise and vibration, the natural landscape and visual environment, histories and cultural heritage resources, and the interactions between them
• Nature of the impacts (i.e. direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative)
• Extent of the impact (geographical area, size of the affected population/habitat/species)
• Magnitude and complexity of the impact
• Probability of the impact

In order to create awareness and obtained a general view regarding the project, public and stakeholder consultations were initiated regarding the project in order to inform them about the various activities to be undertaken in the operation and management of the hydro project. The consultations were also meant to solicit views, concerns, comment and professional inputs regarding the project. A number of indentified stakeholders and concern institutions form part of the consultation.

I. The Superintendents of Lofa County and Local Authorities of towns/villages within the project setting
II. RREA Representative
III. Ministry of Lands, Mines and Energy
IV. Liberia Electricity Corporation
V. Environmental Protection Agency

Key environmental receptors that were investigated within the Impact Assessment phase include:
• Impact to Surface waters within a 1-mile radius
• Impact to other flora and fauna within a 1-mile radius of the project site.
• Impact on air quality, noise and general weather conditions
2.1.3 Project Rationale

The Government of Liberia in partnership with the World Bank is interested in undertaking various programs through the Rural and Renewable Energy Agency (RREA) of Liberia to implement and managed various energy pilot projects in rural Liberia. The Yandohun 30 kW community-managed micro-hydropower installation is one of them. This project is expected to provide the following:

- Benefits of the project for domestic supply and use in small-scale businesses
- Access to electric power for schools and the public.
- Temporary employment opportunities, opportunities for petty trading, employment generation and safer and more efficient operation of key services, through provision of electricity access to the villages along the transmission and distribution lines served by the project,
- Access to reliable electricity supplies, which will lead to better provision and easier management of goods and services, and enable new facilities for processing and storage.
- Availability and supply of safe and clean water (which needs pumping); data management with computers will be made possible and communication facilities like Internet can be made available, including charging of mobile phones; electric lighting will also adds to security at night and enables extended opportunities for work and study.
- Improve in the quality of life and extent of economic opportunity will be changed for the better.
- Social and environmental costs (noise and air pollution) associated with existing generator usage will be reduced and there may be a more limited requirement for firewood cutting and collection.

2.1.4 Plan of the ESIA study

The plan of study for the ESIA is designed to incorporate scientific based analysis of key perimeters and involvement of public participation at the bottom, middle and top levels of concern, interested and affected parties. The rationale for the different levels of study for the various environmental components is taken from the issues raised by interested and affected parties (IAPs), the expected severity of impacts and the level of confidence required in their prediction. The level of information required to develop adequate, practical management and mitigation measures was also a consideration in determining the terms of reference of studies.

2.1.5 EIA Management & Integrative Report Writing

A key component of the EIA process is the direction and quality control of the work undertaken by the specialist. Integration of environmental information in the planning of the project and the harmonizing of the various reports into one, integrated assessment of the project is a key to the
success of the EIA. The EIA is also gear to ensuring environmental and social soundness and sustainability of this project under the World Bank Operations Manuel which will consider among other things integration of environmental and social aspects of the project through key decision making process, assess potential impacts of the proposed project on physical, biological, socio-economic and physical cultural resources, including trans-boundary and global concerns, and potential impacts on human health and safety and the adequacy of the applicable legal and institutional framework, including applicable international environmental agreements, etc.

21.6 Desktop Studies

A number of resource materials were obtained to gathered information on the below sector. Site visits were also conducted to authenticate this information. The sectors studied include:

- Climate
- Topography
- Land Use

2.1.7 Specialist Studies

The following aspects required collation of existing information, field surveys, sampling and mapping being undertaken using geographic information systems and qualitative forms of impact analysis:

I. Fauna and flora including general vegetation of the project area
II. Socio-economic condition, including cultural/ traditional and heritage site
III. Surface water
IV. General weather condition(temperature, rainfall, relative humidity, pressure), including noise, dust and visual aspects
V. Traffic
CHAPTER 3.0: POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 Introduction

There are several policies, laws and regulations specific to areas of environmental management that can affect the operations of micro hydro electricity project. As a matter of policy the Environmental Protection Agency requires an Environmental Impact Assessment for projects that would have a significant impact on the environment. The construction/rehabilitation of a hydro facility as a developmental project is listed amongst those projects requiring an Environmental Permit. As such there is a statutory requirement for conducting an environmental impact assessment for this project. In addition other existing pieces of International and National legislation and regulations would also have relevance to the development and implementation of this project in areas of environmental concern. In this section, the relevant policies, statutory requirements and guidelines and procedures that would impact on the environmental assessment process of this proposed project are outlined.

3.1.1 National Environmental Policy

In February 2007, the Government of Liberia (GOL), through the Ministry of Lands, Mines and Energy (MLME), with the support of the United States Agency for International Development (USAID) published the National Energy Policy.

The principal objective of the National Energy Policy is to ensure universal access to modern energy services in an affordable, sustainable and environmentally-friendly manner in order to foster the economic, political, and social development of Liberia.

The NEP recognizes the fact that energy is essential towards GOL Poverty Reduction Strategy (PRS) and the achievement of the Millennium Development Goals (MDGs).

The NEP assumes the implementation of proposed energy sector reforms founded on three essential features: (1) demonstrating the Government’s resolve for good governance and ensuring financial transparency in all sector transactions; (2) overcoming the significant obstacles to private sector investment in energy supply; and (3) creating the requisite institutional and legal framework and an independent regulatory regime. In undertaking energy sector reform, the Government will also be addressing a key component of Liberia’s commitment to the World Bank and other donors for debt relief under the program for Highly Indebted Poor Countries.
KEY POLICY ISSUES

The NEP addresses the following strategic issues that are implied in the principal policy objective – access, quality, cost, and institutional framework. These issues refer to the need for the various technologies and delivery options for energy products and services to be available, acceptable, affordable, and adequate.

ACCESS
The policy objective is to ensure availability of modern energy services for all Liberians, in both the urban and rural areas.

Currently, about 10% of urban residents and less than 2% of rural residents have electricity access largely from self-generation using expensive imported fuel. By 2015, in line with the Millennium Development Goals as adopted by the Economic Community of West African States (ECOWAS), the Government expects to achieve the following goals:

- 40% of Liberian citizens living in rural and peri-urban areas and using traditional biomass for cooking shall have access to improved stoves and kerosene or efficient-gas cookers in order to reduce indoor pollution;
- 30% of the urban and peri-urban population shall have access to reliable modern energy services enabling them to meet their basic needs (lighting, cooking, communication, and small production-related activities);
- 15% of the rural population and 25% of the schools, clinics, and community centers in rural areas shall have access to modern energy services to meet the same basic needs.

Beyond 2015, the long-term strategy is to make Liberia a carbon neutral country by 2050. The GOL will seek to leverage the country’s biomass and water resources as sources of carbon credits for energy development. The GOL will promote the use of renewable energy such as solar and wind systems in power plants and all large commercial facilities such as supermarkets, hotels, restaurants, entertainment centers, hospitals, and large retail shops and stores. The GOL through the new dedicated Rural and Rural Energy Agency will vigorously pursue the development of mini and micro hydro on the country’s numerous rivers and streams.

It is the policy of the GOL to ensure the availability of quality petroleum products on a cost recoverable, competitive, and affordable basis throughout the nation. In the long term substitute renewable sources such as biodiesel will be employed as fuel for transportation.

QUALITY
The policy objective is to ensure acceptability of energy products and services by adopting standards that are consistent with international best practice.
The GOL shall establish quality standards for all energy products and services which will be monitored and enforced by the Energy Regulatory Board (ERB) and the Bureau of Standards as appropriate; standards will be established to ensure accuracy of meters and gauges, product safety, security, reliability, consistency, purity, and availability as well as timeliness in responding to stakeholder service requests.

The GOL shall also establish energy efficiency standards for all government and commercial buildings and industrial facilities and for importation of fuel-efficient vehicles and energy-efficient light bulbs and home appliances.

It is the policy of the GOL to minimize and eliminate loss, theft, and corruption and to promote international best practices in wholesale and retail energy transactions and in the granting of licenses and concessions.

COST
The policy objective is to ensure affordability through least-cost production and utilization of energy services.

Cost is the main determinant of energy access and quality. It is therefore the policy of the GOL that the development and utilization of all forms of energy shall be done on a least-cost basis. Financial, economic, social, and environmental costs shall all be taken into consideration. The GOL supports the collective global effort to control harmful greenhouse gas emissions responsible for climate change and will seek to balance the environmental costs and benefits of all energy programs. The GOL expects to achieve its access goals for 2015 while reducing greenhouse gas emissions by 10%, improving energy efficiency by 20%, raising the share of renewable energy to 30% of electricity production and 10% of overall energy consumption, and increasing the level of biofuels in transport fuel to 5%.

The GOL is committed to the provision of energy services on a full cost-recovery basis to those who are able to pay and on a targeted subsidized basis to those who can only afford to pay a portion of the cost. This approach will ensure the long-term financial viability of energy service companies while ensuring the affordability of all energy forms for poor consumers. Prices will be set by the operators subject to costs allowed by the Energy Regulatory Board and principles set by the Ministry of Lands, Mines and Energy (MLME) to ensure universal access. The Government will establish a regulatory process for monitoring all costs – economic, financial, social, and environmental – and allocating these to the user (rate payer or polluter) or public (taxpayer) as appropriate.
INSTITUTIONAL FRAMEWORK

The policy objective is to establish an adequate delivery process for energy products and services through a public and private partnership where investment in new infrastructure and services is provided by the private sector to the greatest extent possible, with the public sector providing the supporting policy environment as well as regulatory oversight.

The establishment of an independent and transparent regulatory process will be essential for the creation of an investment environment conducive to increased private sector involvement in the energy sector. To achieve independence and transparency, the institutional framework must avoid conflicts of interest and overlapping roles by separating policy setting, regulatory oversight, and policy implementation and operations.

The Government, through the Ministry of Lands, Mines and Energy, will define and review energy policy. The Energy Regulatory Board will monitor policy implementation by all operators, whether owned by the public sector, private sector, or local communities.

For the better exercise of its functions, the GOL will reorganize the MLME to elevate the attention given to energy and its many uses and benefits. It shall be the policy of the GOL to ensure that the Ministry’s Department of Energy (DoE) is organized efficiently and resourced adequately to discharge its oversight role over all the different energy sub-sectors as well as to direct and supervise, through policy making and planning, the efficient development of the energy sector as a whole.

It shall be the policy of the GOL to balance the interests of consumers with those of firms engaged in the importation, production, transportation, distribution, and sale of energy products and services through the creation of an autonomous regulatory body, enabled by legislation, to eliminate distortions in energy-related markets through transparent, predictable and stable oversight; the Energy Regulatory Board shall be responsible for monitoring all energy policies and standards established by the MLME.

It shall be the policy of the GOL to facilitate and accelerate the economic transformation of rural Liberia by establishing a semi-autonomous agency dedicated to the commercial development and supply of modern energy services to rural areas with an emphasis on locally available renewable resources. The agency, to be called the Rural and Renewable Energy Agency (RREA), will have an operational role under the oversight of the ERB and the policy direction of the MLME. The RREA’s mandate will include integrating energy into rural development planning; promotion of renewable energy technologies; facilitating delivery of energy products and services through rural energy service companies (RESCOs) and community initiatives; and facilitating the
funding of rural energy projects including managing a Rural Energy Fund (REFUND) that will provide low interest loans, loan guarantees, and grants as targeted subsidies to ensure access by the poor.

It is the policy of the GOL that for the foreseeable future Government-owned energy corporations shall continue to operate but shall be restructured to remove all policy making and policy monitoring functions and to improve operational performance through sound commercial business practices. The restructuring of the MLME and the establishment of the ERB and RREA will necessitate changes to the legislation establishing the Liberia Electricity Corporation (LEC), National Oil Company of Liberia (NOCAL), and Liberia Petroleum Refining Corporation (LPRC). Pending the review and revision of the legislation, the policy setting and monitoring functions currently being conducted by NOCAL, LPRC, and LEC staff will be transferred to the appropriate offices of the MLME, ERB, and the Bureau of Standards.

LEC shall be the national grid company with special responsibility to provide support and advice to the MLME on national power system expansion planning. Although LEC will, to some extent, be involved in distribution, the Government is considering other options, including private sector operation and ownership of the Monrovia power distribution business. The Government will encourage and support investment in the power sector by independent power producers (IPPs) and independent power transmission and power distribution companies (IPTs and IPDs). The Government will also encourage large commercial and industrial facilities to utilize cogeneration schemes and to increase the scale of their power sources to provide power for neighboring communities.

In the petroleum sector the Government shall establish the Liberia National Oil Corporation (LNOC) as the Government’s implementing agency for both the upstream and downstream operations. The LNOC shall be created from a merger of the operations of NOCAL and LPRC that are not transferred to the MLME or ERB. For upstream operations, the policy of the GOL is to bring the country’s investment climate in line with international best practice so that the extraction of petroleum resources will benefit all Liberians and the exploration and development will be conducted in an environmentally friendly manner. The GOL, with technical and operational assistance from LNOC’s upstream operations department, shall establish a fully transparent and accountable process for petroleum exploration and commercial development, with regulatory oversight by the ERB. For downstream operations, the GOL, with technical and operational assistance from LNOC’s downstream operations department, shall support competitive private sector investment or participation in new storage depot management or ownership, port management, off-loading facilities for petroleum products, up-country storage depots, tankers moving petroleum products around the country, and in construction and operation of a refinery primarily devoted to exports.
It is the policy of the GOL to link its long-term energy policy with that of the ECOWAS region. The ECOWAS Energy Protocol constitutes a key building block of Liberia’s national energy policy. For this reason, Liberia’s goals on energy access are in line with the ECOWAS goals and will move the country toward achieving the 2015 Millennium Development Goals. Liberia will establish a Saint Paul River Authority (SPRA), modeled on the US Tennessee Valley Authority (TVA) for the development of its large-scale hydropower potential to fuel the economy and to export power to the West African Power Pool (WAPP). Liberia will also join the West Africa Gas Pipeline (WAGP) and encourage electricity developers in neighboring countries to use this gas for power generation which can then be transmitted to Liberia.

The GOL recognizes that there are areas of overlap and inter-linkage between energy and other sectors and it is therefore necessary to re-establish the National Energy Committee (NEC), in place before the civil crisis, to facilitate coordination between energy-oriented organizations in the public and private sector and developers and users of related infrastructure services. The NEC will also provide a forum for coordination among domestic, regional, and international stakeholders. The NEC will therefore fulfill the ECOWAS recommendations for member countries to set up a cross-sectoral and multi-actor cooperation mechanism equipped with the human, technical, and financial resources required to discharge its coordination mandate.

SMALL LIGHT TODAY, BIG LIGHT TOMORROW

The policy objective is to establish and communicate a strategic roadmap that will serve as a reference for performance measurement in the implementation of the NEP.

The Government has adopted a three-pronged strategy towards the realization of the vision expressed by the principal objective of the NEP – the short term (emergency phase), the medium term (capacity building phase) and the long term (development phase). President Ellen Johnson Sirleaf, in the dedication ceremony for the re-establishment of public power supply in Monrovia, summarized the strategic roadmap with the phrase “Small light today, big light tomorrow.” This NEP paves the way from the small light to the big light.

The emergency phase was launched in January 2006 as a cornerstone of Liberia’s post-conflict stabilization and redevelopment program. During this phase, several pilot projects have been implemented to serve as the foundation for the rebuilding of the country. The projects have also served to provide lessons for the development of the NEP. Over the medium term, from 2008 to 2015, the strategy is to develop the country’s institutional capacity for policy implementation. During this phase, the Government will roll out and extend the emergency phase pilot projects and also facilitate the first major private sector investments in power generation. The long term, beyond 2015, will have the objective of vision realization and will be focused on the development of the country’s large hydropower and other renewable resources.
ELECTRICITY SECTOR REFORM

Recognizing the inadequacies in the operation of the electricity sector, the NEP also addresses the issues of needed reform in the sector. It builds on the positive components of the existing policies and removes the factors responsible for its inefficiencies.

STATEMENTS OF POLICY

1. It is the policy of the Government to facilitate and accelerate the economic transformation of rural Liberia by establishing a semi-autonomous agency dedicated to the commercial development and supply of modern energy services to rural areas with an emphasis on locally available renewable resources.

2. It is the policy of the Government to support the development of all economically viable, socially acceptable, and environmentally friendly rural energy projects regardless of financial viability. Social acceptability shall include the need to provide preference to projects by Liberian nationals and those that take account of diversity and national interest.

3. It is the policy of the Government to ensure that the utilization of biomass and other renewable resources for energy does not contribute to deforestation or to food insecurity and will adopt appropriate environmental and agricultural support strategies such as tree-replanting programs and limiting biofuel production to non-edible plants or food crops that are surplus to requirements.

4. It shall be the policy of the Government to prioritize projects on the basis of economic, demographic, and geographical criteria designed to ensure enhanced access with equity.

OFF-GRID POWER AND RENEWABLE ENERGY

Considering that remote and low income rural communities have been neglected for so long, the NEP provides for the Government to establish special incentives and financing mechanisms to facilitate the availability of affordable electricity supplies. The development and growth of private and community-owned rural energy service companies with the support of GOL. This shall include quality and cost efficiency for rural dwellers.

Under this framework, the Government shall create a Rural and Renewable Energy Agency that is responsible to provide the special support required for remote and low income communities. The ultimate goal of the RREA and the REFUND is to ensure that every household, commercial
enterprise, and social and administrative center in every village and town of every district of every county has access to affordable, sustainable and environmentally friendly modern energy services.

STATEMENTS OF POLICY

1. It is the policy of the Government to facilitate and accelerate the economic transformation of rural Liberia by establishing a semi-autonomous agency dedicated to the commercial development and supply of modern energy services to rural areas with an emphasis on locally available renewable resources.

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4. It shall be the policy of the Government to prioritize projects on the basis of economic, demographic, and geographical criteria designed to ensure enhanced access with equity.

3.1.2 National Environmental Policy

The National Environmental Policy of Liberia provides:

Systematic and logical framework by which to address environmental issues. Section 4.7 of the policy calls for an ESIA on all major developmental, socio economic and land use activities in any form which may have adverse effect/impact on the environment to one degree or another

Benchmarks for addressing environmental problems in the medium and long term; Context for financial donor support to particular sector and non sector; and, Demonstrates Liberia’s commitment to sustainable management of the environment and natural resources

The Act Creating the Environmental Protection Agency (EPA) provides:

For an autonomous entity empowered to ensure that environmental policies and laws are implemented;
For a Policy Council to propose and update environmental policies as required/needed; and.
For an institutional arrangement that supports the agency in carrying out its mandate/functions;

The Environmental Protection & Management Law provides;
The tools for environmental management;
For a framework for the effective enforcement of environmental standards; 
For sector-specific regulations, and, 
For an integration of concepts of international environmental laws into national environmental protection and development frameworks.

### 3.1.2.1 Environmental & Social Impact Assessment (ESIA)

To fulfill the requirements of the EPAL and the Ministry of Lands, Mines & Energy, the Proponent will conduct an Environmental and Social Impact Assessment (ESIA). In so doing, the services of an independent EPA licensed EIA Evaluator has been contracted, who will need to collect a host of data on social, economic and environmental issues in the proposed project area. Upon completion, a report will be compiled and submitted to the EPA. This report will be evaluated by the EPA and relevant stakeholders. The ESIA Report will be based on environmental and physical data generated throughout the ESIA process. In the report, the ESIA consultant will provide a list of the potential environmental effects that will occur in the project area. The ESMP component of the report will provide information on strategies to mitigate environmental impacts that will occur directly and indirectly.

### 3.1.3 The National Forestry Policy

The aim of the forestry policy of Liberia is to conserve and sustainably manage all forest areas, so that they will continue to produce a complete range of goods and services for the benefit of all Liberians and contribute to poverty alleviation in the nation, while maintaining environmental stability and fulfilling Liberia’s commitments under international agreements and conventions. In order to achieve this aim, the following specific objectives will be pursued:

To ensure that commercial forestry, community forestry and forest conservation activities are integrated and balanced to optimize the economic, social and environmental benefits from the forest resource.

- To conserve a representative sample of forest ecosystems so that important environmental functions are maintained.
- To contribute to the national development goals of poverty alleviation and increased food security by increasing the opportunities for forest-based income generating activities.
- To grant more equitable access to forest resources so that the potential for future conflict is reduced and the benefits from forestry development are shared throughout Liberian society.
- To ensure that all stakeholders participate in the formulation of forestry policies and in the conservation and management of the forest resource.
- To maximize the contribution of the sector to income, employment and trade through the development of appropriate processing activities.
3.1.4 Draft Fisheries Policy

There has been no fisheries policy in Liberia for over a decade as a result of the conflict. With FAO assistance, The Ministry of Agriculture is now formulating a national fisheries and aquaculture policy intended to strengthen Liberia’s maritime and fisheries laws, regulations and capacity to ensure sustainable management and development.

Key elements of the draft policy include:

Guiding principles

   The Government will endeavour to maintain ecosystems health and functioning, environmental protection, conservation and enhancement of mangroves and wetlands, maintenance of biological diversity, and pollution free marine and freshwaters.

2. Global Responsibility.
   The Government will work cooperatively with Governmental and Non-Governmental agencies, institutions and organizations that are involved in environment and natural resources management to strengthen environmental conservation strategies, and will actively pursue collaboration and cooperation with countries in sustainable fisheries conservation, protection and management.

3. Responsible Fisheries Management.
   The Government shall ensure that the national fisheries and aquaculture policy is consistent with the FAO Code of Conduct for Responsible Fisheries (CCRF). Provisions of the CCRF that are relevant to the sustainable development of fisheries and aquaculture in Liberia will be incorporated in the national fisheries legislation and accompanying regulations.

   The Government shall seek the participation of grassroots fisheries community organizations, farming communities engaged in aquaculture, the private sector fishing industries, national and international Non-Governmental Organizations involved in fisheries and aquaculture, and the country’s development partners, in sustainable fisheries management.
5. **Transparency and Accountability.**

There shall be openness in access to information, in the elaboration of plans, and in decision-making. Also, the decision makers should be accountable and be available to answer to the stakeholders who may be affected by their decisions.

The draft fisheries policy provides for a number of policy areas concerning the environment and conservation of biodiversity. These areas are highlighted below.

I. **Monitoring, control and surveillance (MCS).** The objective is to establish a national surveillance system capable of assuring national security and protecting the Liberian territorial waters and the EEZ (Exclusive Economic Zone). With particular reference to fisheries, the primary objectives are to control and monitor fishing activities and prevent poaching and other forms of IUU fishing;

II. **Fisheries scientific research.** Fisheries research is an essential component of fisheries development and management. The policy will develop a comprehensive fisheries research program to provide Government the scientific information and knowledge it needs to make informed decisions on fisheries management and development. Elements include:

a. **Conservation and enhancement of the aquatic environments and ecosystems.** The overall objective of this policy area is to maintain ecosystems health and functioning through environmental protection, conservation and enhancement of mangroves and wetlands, maintenance of biological diversity, and maintaining pollution free marine and freshwaters. Measures for the protection of these natural resources and habitats and the maintenance of biological diversity will be pursued in close collaboration with the line Ministries and Departments of the natural resources sectors, the Environment Protection Agency, the Municipalities and communities and the few NGO’s working in these sectors.

b. **Interagency collaboration and cooperation in sustainable fisheries management and development.** In order to improve fisheries management and ensure sustainable implementation of development programs and projects, the MOA through the BNF will establish meaningful working relationships with other Government agencies and institutions whose mandates touch on fisheries and aquaculture, environment and natural resources conservation and management.
c. **Promote sub-regional, regional and international cooperation in fisheries management.** The policy objective is to foster external collaboration and cooperation in fisheries management. Liberia will work to strengthen sub-regional, regional and international cooperation in fisheries management. The country will accede to international fisheries agreements, conventions and protocols as an essential foundation for partnership and sub-regional and regional cooperation in sustainable fisheries management.

d. **Continue collaboration, cooperation and strengthening of the Fishery Committee for the West Central Gulf of Guinea for Liberia, Cote D’Ivoire, Ghana, Togo, Benin and Nigeria to promote sustainable fisheries management**, to better manage shared and transboundary fish stocks through joint research programs, joint management of coastal zones and ecosystems, collaboration on pollution control, harmonization of national legislation and policies, and in the joint monitoring, control and surveillance activities. Integrating Youths and Ex-combatants into fisheries and aquaculture development.

### 3.1.5 International Policy

In 1992, at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro. Agenda 21 was adopted as a program of action for the 21st Century. Twenty-seven (27) environmental principles were outlined at the UNCED conference as an attempt to enshrine a charter for the protection of the Earth. Three principles outlined in Agenda 21 action program can be applied to the environmental impact assessment process for this development. These are:

Principle 1, which states that human beings are at the center of concerns for sustainable development and that they are entitled to a healthy and productive life in harmony with nature.

Principle 3 which mentioned that the right to development must be fulfilled so as to equitably meet development and environmental needs of present and future generations and;

Principle 17 which states that environmental impact assessments should be a national instrument, that shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to the decision of a competent national authority.
The above principles outlined in Agenda 21 can be seen as mechanisms by which the global community will cooperate to promote sustainable development. Within this context, the Liberian Government has put into place its National Environmental Policy so as to include the principles of Agenda 21 and have included aspects related to the above environmental principles.

3.1.5.1 WORLD BANK OPERATIONS MANUAL

Within the Bank’s Operations Manual, key policies and procedures are outlined under each sector’s operational principles: Environmental and Social Safeguard Policies and Procedures.

A. Environmental Assessment — OP/BP 4.01

To help ensure the environmental and social soundness and sustainability of investment projects under the Bank’s Operations Manuel, these issues were considered:

1. Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment (EA) so that appropriate studies are undertaken proportional to potential risks and to direct, and, as relevant, indirect, cumulative, and associated impacts. Use sectoral or regional environmental assessment when appropriate.

To support integration of environmental and social aspects of projects into the decision-making process.

2. Assess potential impacts of the proposed project on physical, biological, socio-economic and physical cultural resources, including transboundary and global concerns, and potential impacts on human health and safety.

3. Assess the adequacy of the applicable legal and institutional framework, including applicable international environmental agreements, and confirm that they provide that the cooperating government does not finance project activities that would contravene such international obligations.

4. Provide for assessment of feasible investment, technical, and siting alternatives, including the "no action" alternative, potential impacts, feasibility of mitigating these impacts, their capital and recurrent costs, their suitability under local conditions, and their institutional, training and monitoring requirements associated with them.

5. Where applicable to the type of project being supported, normally apply the Pollution Prevention and Abatement Handbook (PPAH). Justify deviations when alternatives to measures set forth in the PPAH are selected.
6. Prevent and, where not possible to prevent, at least minimize, or compensate for adverse project impacts and enhance positive impacts through environmental management and planning that includes the proposed mitigation measures, monitoring, institutional capacity development and training measures, an implementation schedule, and cost estimates.

7. Involve stakeholders, including project-affected groups and local nongovernmental organizations, as early as possible, in the preparation process and ensure that their views and concerns are made known to decision makers and taken into account. Continue consultations throughout project implementation as necessary to address EA-related issues that affect them.

8. Use independent expertise in the preparation of EA where appropriate. Use independent advisory panels during preparation and implementation of projects that are highly risky or contentious or that involve serious and multi-dimensional environmental and/or social concerns.

9. Provide measures to link the environmental assessment process and findings with studies of economic, financial, institutional, social and technical analyses of a proposed project.

10. Provide for application of the principles in this Table to subprojects under investment and financial intermediary activities.

11. Disclose draft EA in a timely manner, before appraisal formally begins, in an accessible place and in a form and language understandable to key stakeholders.

Natural Habitats- OP/BP 4.04,

B. Natural Habitats

To promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions. The following objectives were adopted for the purpose of this ESIA:

1. Use a precautionary approach to natural resources management to ensure opportunities for environmentally sustainable development. Determine if project benefits substantially outweigh potential environmental costs.

2. Avoid significant conversion or degradation of critical natural habitats, including those habitats that are (a) legally protected, (b) officially proposed for protection, (c) identified by authoritative sources for their high conservation value, or (d) recognized as protected by traditional local communities.

3. Where projects adversely affect non-critical natural habitats, proceed only if viable alternatives are not available, and if appropriate conservation and mitigation measures, including
those required to maintain ecological services they provide, are in place. Include also mitigation measures that minimize habitat loss and establish and maintain an ecologically similar protected area.

4. Whenever feasible, give preference to siting projects on lands already converted.

5. Consult key stakeholders, including local nongovernmental organizations and local communities, and involve such people in design, implementation, monitoring, and evaluation of projects, including mitigation planning.

6. Provide for the use of appropriate expertise for the design and implementation of mitigation and monitoring plans.

7. Disclose draft mitigation plan in a timely manner, before appraisal formally begins, in an accessible place and in a form and language understandable to key stakeholders.

Involuntary Resettlement- OP/BP 4.12,

Objectives

Operational Principles

D. Involuntary Resettlement

To avoid or minimize involuntary resettlement and, where this is not feasible, to assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

1. Assess all viable alternative project designs to avoid, where feasible, or minimize involuntary resettlement.

2. Through census and socio-economic surveys of the affected population, identify, assess, and address the potential economic and social impacts of the project that are caused by involuntary taking of land (e.g., relocation or loss of shelter, loss of assets or access to assets, loss of income sources or means of livelihood, whether or not the affected person must move to another location) or involuntary restriction of access to legally designated parks and protected areas.

3. Identify and address impacts also if they result from other activities that are (a) directly and significantly related to the proposed project, (b) necessary to achieve its objectives, and (c) carried out or planned to be carried out contemporaneously with the project.
4. Consult project-affected persons, host communities and local nongovernmental organizations, as appropriate. Provide them opportunities to participate in the planning, implementation, and monitoring of the resettlement program, especially in the process of developing and implementing the procedures for determining eligibility for compensation benefits and development assistance (as documented in a resettlement plan), and for establishing appropriate and accessible grievance mechanisms. Pay particular attention to the needs of vulnerable groups among those displaced, specially those below the poverty line, the landless, the elderly, women and children, Indigenous Peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.

5. Inform displaced persons of their rights, consult them on options, and provide them with technically and economically feasible resettlement alternatives and needed assistance, including (a) prompt compensation at full replacement cost for loss of assets attributable to the project; (b) if there is relocation, assistance during relocation, and residential housing, or housing sites, or agricultural sites of equivalent productive potential, as required; (c) transitional support and development assistance, such as land preparation, credit facilities, training or job opportunities as required, in addition to compensation measures; (d) cash compensation for land when the impact of land acquisition on livelihoods is minor; and (e) provision of civic infrastructure and community services as required.

6. Give preference to land-based resettlement strategies for displaced persons whose livelihoods are land-based.

7. For those without formal legal rights to lands or claims to such land that could be recognized under the laws of the country, provide resettlement assistance in lieu of compensation for land to help improve or at least restore their livelihoods.

8. Disclose draft resettlement plans, including documentation of the consultation process, in a timely manner, before appraisal formally begins, in an accessible place and in a form and language that are understandable to key stakeholders.

9. Apply the principles described in the involuntary resettlement section of this Table, as applicable and relevant, to subprojects requiring land acquisition.

10. Design, document, and disclose before appraisal of projects involving involuntary restriction of access to legally designated parks and protected areas, a participatory process for: (a) preparing and implementing project components; (b) establishing eligibility criteria; (c) agreeing on mitigation measures that help improve or restore livelihoods in a manner that maintains the sustainability of the park or protected area; (d) resolving conflicts; and (e) monitoring implementation.
11. Implement all relevant resettlement plans before project completion and provide resettlement entitlements before displacement or restriction of access. For projects involving restrictions of access, impose the restrictions in accordance with the timetable in the plan of actions.

12. Assess whether the objectives of the resettlement instrument have been achieved, upon completion of the project, taking account of the baseline conditions and the results of resettlement monitoring.

G. Physical Cultural Resources

To assist in preserving physical cultural resources and avoiding their destruction or damage. PCR includes resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites),

1. Use an environmental assessment (EA) or equivalent process to identify PCR and prevent or minimize or compensate for adverse impacts and enhance positive impacts on PCR through site selection and design. aesthetic, or other cultural significance.

2. As part of the EA, as appropriate, conduct field based surveys, using qualified specialists.

3. Consult concerned government authorities, relevant non-governmental organizations, relevant experts and local people in documenting the presence and significance of PCR, assessing the nature and extent of potential impacts on these resources, and designing and implementing mitigation plans.

Environmentally and Socially Sustainable Development and International Law.

Projects on International Waterways

Applicability of Policy

1. This policy applies to the following types of international waterways:
   a. any river, canal, lake, or similar body of water that forms a boundary between, or any river or body of surface water that flows through, two or more states, whether Bank 1 members or not;
   b. any tributary or other body of surface water that is a component of any waterway described above and
   c. any bay, gulf, strait, or channel bounded by two or more states or, if within one state, recognized as a necessary channel of communication between the open sea and other states and any river flowing into such waters.
2. This policy applies to the following types of projects:

a. hydroelectric, irrigation, flood control, navigation, drainage, water and sewerage, industrial, and similar projects that involve the use or potential pollution of international waterways

b. detailed design and engineering studies of projects, including those to be carried out by the Bank as executing agency or in any other capacity.

Agreements/Arrangements

3. Projects on international waterways may affect relations between the Bank and its borrowers and between states (whether members of the Bank or not). The Bank recognizes that the cooperation and goodwill of riparians is essential for the efficient use and protection of the waterway. Therefore, it attaches great importance to riparians' making appropriate agreements or arrangements for these purposes for the entire waterway or any part thereof. The Bank stands ready to assist riparians in achieving this end. In cases where differences remain unresolved between the state proposing the project (beneficiary state) and the other riparians, prior to financing the project the Bank normally urges the beneficiary state to offer to negotiate in good faith with the other riparians to reach appropriate agreements or arrangements.

Notification

4. The Bank ensures that the international aspects of a project on an international waterway are dealt with at the earliest possible opportunity. If such a project is proposed, the Bank requires the beneficiary state, if it has not already done so, formally to notify the other riparians of the proposed project and its Project Details. If the prospective borrower indicates to the Bank that it does not wish to give notification, normally the Bank itself does so. If the borrower also objects to the Bank's doing so, the Bank discontinues processing of the project. The executive directors concerned are informed of these developments and any further steps taken.

3.1.6 Environmental Health and Safety General Guidelines

These guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these Guidelines are applied as required by their respective policies and standards. These guidelines are designed to be used together with the relevant industry sector EHS Guidelines which provides guidance to users on EHS issues in specific industry sectors.

3.1.6.1 Power EHS Guidelines

The EHS Guidelines for Electric Power Transmission and Distribution include information relevant to power transmission between a generation facility and a substation located within an
electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas.

### 3.1.7 International Policy Commitments

Liberia is signatory to a number of international conventions and treaties. These are presented in below.

<table>
<thead>
<tr>
<th>Convention/Treaty</th>
<th>Objectives</th>
</tr>
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</table>
| 1. Convention on Biological Diversity (CBD)                                      | 1. Promote Conservation of Biological Diversity  
2. Sustainable use of its components  
3. Fair and equitable sharing arising out of the utilization of genetic resources |
| 2. The Cartagena Protocol on Biosafety to the Convention on Biological Diversity | To contribute to ensuring an adequate of protection in the field of living modified organisms resulting from modern biotechnology |
| 4. United Nations Convention to Combat Desertification                            | To combat desertification and mitigates the effect of drought in countries experiencing serious droughts and or desertification |
| 5. The United Nations Framework Convention on Climate Change                      | To achieve stabilization of green house gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climatic system |
| 6. Kyoto Protocol                                                                | To strengthen the commitment of developed country Parties with a view to reduce their overall emissions                                      |
| 12. Abidjan Convention And Protocol on Management And Protection Of Coastal and Marine Environment In the Sub-Region | For the Cooperation in the Protection and Development of the Marine and Coastal Environment of West African region |
| 13. Ramsar Convention On Wetlands                                                | 1. To manage wetland systems so that the human uses of these areas are undertaken in such a way as to retain their natural capital for future generation.  
2. To encourage and support countries to develop and implement national policy and legislative frameworks, education and awareness raising programs, as well as inventory, research and training projects. |
| Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) | Ensures that international trade in specimens of wild animals and plants does not threaten their survival. |


CHAPTER 4.0 DETAILED PROJECT DESCRIPTION

4.1 Introduction

Yandohun micro-hydropower station is to be built on the Yando River, known in the local language as Yando-wolee. The river is a tributary to the Maigovi River. The Maigovi River joins the Moa River which found a tributary to the Mankona River which forms the boundary between Liberia and Sierra Leone.

The key features of the Project include a dam, an underground water conveyance system and a power station. The Yandohun micro-hydro station located on the Yando River will be supplied through a built forebay tank(reservoir) . The water from the hydro station reservoir will be diverted, via a headrace tunnel and an underground penstock, to a power station located about 100-150m below the steep slope and also overlooking the abandoned forebay tank. The power house is also located about 1Km downstream of the dam. The difference in elevation between the forebay tank and the power station is about 42 m. From the power station the water is conveyed back to Yando River via a short tailrace canal.
The total estimated cost of the Yandohun micro-hydro station is about 535 thousand United States Dollars, including pre-construction cost, mobilization and contingencies. Preliminary construction activities which will include mobilization of work force from Yandohun and nearby towns and villages, the rehabilitation of the labor intensive access route leading to the dam and clearing of areas for construction of the warehouse is expected to commence before the end of
2010 with actual construction work to commence the first quarter of 2011. The project is expected to have a voluntary work force of more than a hundred persons with actual employed and technical work force around 10 persons. The description of this project is based on field assessment of the abandoned Yandohun hydro dam and additional information obtained from the documented assessment study titled “Catalyzing New Renewable Energy in Rural Liberia”, Yandohun Micro Hydro Power. The Yandohun Micro Hydro Power Project which will involve the rehabilitation of the previously 30kW community-managed micro-hydropower installation is part of a plan to develop one or two pilots utilizing on-site solar power generation in other rural areas of the country that will not be connected to the West Africa Power Poll (WAPP) or other grid in the next five years.

4.2 Project Components

4.2.1 General

The community managed micro-hydro power project is meant to produce electricity to cover the towns of Yandohun and surrounding villages of Dangalahun-1 and Dangalahun-2 which were previously covered by the electricity. Other surrounding towns and villages are expected to be covered in the near future. The electricity is expected to sustain the socio and economic growth in the region, by utilizing the head created by the dam and the water conveyance system. To accomplish this certain infrastructure facilities will be constructed as follows:

- The rehabilitation of the dam on the Yando River and the forebay tank(reservoir) constructed to supply the power station.
- Structures to divert the water from the reservoir to the power station.
- A power station with the necessary facilities to generate electricity.
- A transmission line to connect the power station with the local grid.
- Rehabilitation of labor intensive road net works to connect the project site and surrounding towns and villages to the national road system.
- Auxiliary areas to enable construction and operation of the Project.

The various project components are described in more detail technical specification below:

The plant capacity is expected to generate a power of 60kW and a design flow of 260 lit/S (0.26 m3/S), a gross head of 35.2m and a net head of 34m. The weir site will be reinforced with concrete with height of 2m maximum and length of 25m. The old weir will be rehabilitated and reinforced. It will be located on the gneissic bedrock exposed at that location. A storage pond will be created by the weir, which will be within the existing river bed. This means that likely no people will be affected as a consequence of the rehabilitation of the weir and the storage. There will also be a reinforced concrete headrace channel with internal width of 650mm, internal height of 500mm, wall thickness of 100mm and a length of 172m.
Headrace Channel will start from the proposed weir point and then runs along a contour right bank of the stream. This will run along the moderately sloping rock all along its path up to the forebay tank.

Figure 2: Existing Dam

The forebay tank will also be constructed with reinforced concrete at a depth of 2650mm, width of 2500mm and a wall thickness of 300mm. The Forebay tank will be located on a moderately sloping area, on a sloping mountain parallel to stream. At this location residual soil cover is estimated to be around 3-4mtrs.
The Penstock starts from the forebay tank and runs westward direction until it reaches power house. It will be constructed with steel with a diameter of 420mm and length of 147m and have a butterfly valve with gear mechanism. There is an existing penstock line, where the new penstock to be installed will run parallel to.
A single story house building with machine floor area, control room and office room will be constructed to house the power house. The power generated output is expected to be an electro-mechanical governor with micro processor control and ballast load (water cooled) of 60kW. A 400v, 50Hz, 0.8 pf. 3 phase generator voltage will be required to run the Francis turbine (horizontal shaft), 70.5 kW, with a rated discharge of 260 Lit/S. The power house will also have a synchronous generator with AVR to serve as a stand by generator, generating 60kW power, 400v, 3 phase, 50Hz. The power house will also have a free standing control and protection panel with indicators, line analyzers, protection relays (earth fault, under/over voltage, under/over frequency, over current, phase failure etc.) to regularly monitor the power outputs. The plant will operated automatically with the governor based on the distribution load. However, a plant operator is needed to supervise the operation of equipment and maintain records.

A transformer substation is expected to be set up in three locations, Yandohun, Dangalahun 1 and Dangalahun 2. These substations will be equipped with over current protection, surge protection and earthing. The transformer substations will composed of the following specifications: 01 No. 75 kVa, 400V/11kV step- up transformer at power plant, step-down transformers 11 kV400 V-03 No.s at load centers. The transformer voltage will be 11kV and transmission line composed of single circuit, Weasal conductor overhead pole line for length of 4.6 km. The low voltage distribution lines of 3 phase, LV distribution lines by PVC bundled conductors on wooded or concrete poles are also expected for the project.

Finally, the service connections will composed of a single phase service connections to households by 2 core, PVC insulated overhead cable and 3 phase line to the industrial and bulk consumers.

Figure 5: Old Power Plant (turbine)
4.3 Project Setting

The total area to be impacted by the project construction and activity is estimated to be around 9 acres. This includes:

- the areas to be occupied by project infrastructures such as power house, forebay tank, penstock, weir;
- area to be traversed by the transmission lines which is put at about 2.5 km; and
- 10m rights of way (ROW) along the transmission lines (approximately 6 acres)

The project operations in terms of electricity supply will extend up to 2.5 km from the project base (0351234/0897854/ 0351323/0897822), covering the towns of Dangalahun 1, Yandohun and Dangalahun 2.

The towns of Yandohun and Danglahun 1 and 2 fall within the following coordinates:

- 0350340/0896157
- 0351387/0897733
- 0351188/0898912

4.4 Project Ownership

The Yandohun micro hydro power project is a community based project that is being implemented in partnership with the World Bank as part of its general assistance to Liberia rural energy sector across the country. It is owned by the Government of Liberia through the RREA. The project however, will eventually be a micro managed one by the local inhabitant through a committee set up with representation from the affected towns/villages.

The Government of Liberia through the Rural and Renewable Energy Agency (RREA) has offices located on the 2nd Floor of the Liberia Electricity Corporation (LEC).

4.5 Project Historical Aspect

Investigations conducted for the sake of this project reports that the project area has been extensively subjected to subsistence agricultural activities as the primary livelihood for the rural inhabitants of the area. The area has also been subjected to massive hunting activities. Some portion of the area has also been logged by the locals for housing activities. Areas earmarked for the project has already been disturbed through initial site preparation (clearing of vegetation around previous hydro site, labor intensive access route, etc.).
The previous 30 kW hydro power plant was built in the late ’70 through the initiative of a Peace Corps named Gary Duncan locally known as Selley (elephant in Gbandi). The project was funded by the United Stated Agency for International Development (USAID) with the total involvement of the towns of Yandohun and Dangalahun 1. Inhabitants of these towns and other surrounding ones carried poles and other accessories for the hydro on their heads. Labor intensive routes were created in order to bring the first machine which created the more than 1km road leading to the hydro site.

As a result of the sustained electricity, the town of Yandohun became famous. Surrounding towns and villages brought in their produce like coffee, cocoa and rice to be processed at a mill which was situated in the town. The town also became socially active because of the street lights and entertainment sites selling cold drinks.

The result of some of these benefits from the town compared the French medical based International Non Governmental Organization(INGO) Medicine San Frontier(MSF) during the heat of the civil war to locate its headquarter in the town in order to render services to other surrounding towns. However, as the civil crisis intensify and the town was invaded by rebels, the hydro dam was misused leading to the destruction and subsequent looting of the dam.

4.6 Statement of Need

Beginning from the year 1990-2005, Liberia has been faced with instability and severe decline in infrastructure, social services and employment. President Ellen Johnson Sirleaf, Africa’s first female President, took office in mid-January 2006 facing severe challenges. Fourteen years of civil war had destroyed much of Liberia’s physical and human capital and severely damaged its institutions. The new government endorsed programs aimed at improving governance, building capacity, and managing post conflict recovery through establishing policies to stabilize the economy and support economic reconstruction. Although progress has been substantial (broad price stability, and accomplished structural reforms to reinforce public financial management), the government still faces numerous challenges. Per capita GDP was estimated at US$195 in 2007, still below prewar levels, ranking Liberia among the poorest countries in the world; in current circumstances, the nation is unlikely to achieve any of the MDGs by 2015. According to the nation’s Poverty Reduction Strategy (PRS), 64% of the population lives below the poverty line, and about 48% live below the extreme poverty line. Of these, 73% reside in rural areas. In order to improve these conditions, GOL is determined to create jobs and opportunities that would improve the condition of the people in support of its poverty reduction strategy.

The rehabilitation of the proposed Yandohun micro managed hydro power plant is an approach by the Liberian Government to create economic livelihood and provide basic social services for the rural areas. The Government of Liberia through the Rural and Renewable Energy Agency is confident that the project development is sustainable for the following reasons:
- The project is not taking away anything from the environment but utilizing the flowing water to produce power and eventually release the water back into the river.
- The water leading to the forebay tank (reservoir) is carefully trapped through sieve to avoid aquatic fauna from coming in contact with the power plant.
- There will be no cutting down of vegetation except clearing previously affected area for the rehabilitation processes.
- The project involves no use of chemical to add to the surface thereby polluting the water body.
- The main rationale for the present proposed project is the expected positive economic and development expectations.

4.7 Project Activities/Operation

4.7.1 Introduction

The construction phase of the project shall comprise of site preparation to rehabilitate access routes and remove obstructing vegetation. This will be followed by the rehabilitation of plant operational and support facilities. This will include upgrading of the existing plant along with ancillary facilities to support the project. The operation of the project will include generation of electricity from the mini hydro-plant, transmission and distribution to 3 communities, using existing light poles. The project is also expected to have as a standby, a mini generator to supply power in the event where water supply is too low to effectively run the dam.

4.7.2 Design

The project is designed such that the previous 30Kw hydro power plant located in Yandohun will be rehabilitated and upgraded to a capacity of 60Kw. The proposed head and plant capacity will have a design flow of 260 lt. /Sec (0.26 m3/S) required to generate 60 kW of electrical power. The design flow will also follow these technical processes:

1. Weir site

The old weir will be rehabilitated and reinforced. A small pond will be created behind the proposed weir. It will be limited to the river channel area lined with boulders, providing stable condition for the perimeter of the pond.

2. Headrace Channel

The Headrace Channel will begin from the proposed weir point and continue along a contour right bank of the stream. This will run along the moderately sloping rock all along its path up to the forebay tank.

3. Forebay Tank
The Forebay tank will be located on a moderately sloping area, on a sloping mountain parallel to the stream.

4. Spillway channel

A spillway channel route will originate from the forebay tank and the channel will be comprised of several steps to reduce the speed of falling water on a slope.

5. Penstock Route

The Penstock starts from the forebay tank and runs in a westward direction until it reaches power house. There is an existing penstock line, where the new penstock is to be installed in parallel to this one.

6. Power House/Tailrace

The proposed power house and tailrace will be located on a terrain with a gentle slope towards the river. The river section adjacent to the power house shows fresh massive gneissic rock exposures.

The project is designed for a lifespan of more than ten years. The materials/equipment/infrastructure to be used in the project shall include:

4.7.3 Infrastructure Development

Once the land has been cleared and obstruction vegetation removed the construction of infrastructure will begin. The main infrastructure required for development includes rehabilitation of the access roads, construction of site house to be use for construction workers and eventually turned into guest house for the town at the end of the construction.

4.7.3.1 Equipment/Materials

The types of equipment to be employed in the operation of the hydro power plant will include:

**Construction**

Motor grader, Front and Back hand loader, Pick-up trucks, Jeeps etc, crushed aggregates, steel rods, cement etc.

4.8 Manpower for the Project & Training

The project shall provide employment for approximately 10 or more persons. Apart from the direct employment, the provision of electricity will provide various sources of income generation
for residents in and outside of the project area. An estimated 100 persons will be required to provide community volunteer service for the development of the project. Following the construction of the power plant and its facilities a community management team (Yandohun Hydro Power Management Team) will be constituted to take over the management of the facilities. The Team will receive training required for the operation and maintenance of the facilities and be charged with the responsibility of working with the rest of the community for the sustenance of the project.

**Fuel storage**

The storage of fuel and the distribution of petroleum products will be operated by the company at designated project sites. A storage tank for diesel fuel, with capacities of 1500 to 3000 gallons will be installed and maintained within a secondary containment area to prevent release in the event of tank failure. Secure drum will be stored at the facility for the collection and storage of other lubricants associated with machinery operations.

### 4.9 Project Schedule

Initial project activities with respect to administrative set up and technical preparation have already commenced. The implementation of project operational activities is scheduled to commence following the granting of the EIA Permit by the EPA. The project is expected to cover a period of ten months.

There is always a risk of pre-mature abandonment for technical, organizational, political or financial reasons. With the current peace and security existing in the country couple with the capacity and commitment of the World Bank to the project and the local inhabitants’ willingness to manage the project, complete abandonment seems unlikely.

### 4.10 Alternatives- No Action (Do-Nothing)

The alternative analyzed in the ESIA is a “Do-Nothing” alternative:

This alternative would mean that the project would not be constructed. Under the No-action alternative the status quo with respect to impact on land use, vegetation, wildlife or protected species in the project area would continue. The No-action alternative would impact socio-economic conditions in the communities around the proposed Project. No-action is unlikely to attract socio-economic improvements to the area. No-action may lead youth to migrate to other areas where there are improved conditions and opportunities for growth.
CHAPTER 5.0 DESCRIPTION OF THE ENVIRONMENT

5.1 Introduction

This chapter presents a description of the project environment prior to the commencement of the rehabilitation of the Yandohun micro-managed hydro project. It also includes information essential for assessing and identifying the environmental effect of the project.

5.2 Biological Environment

5.2.1 Ecological information

The immediate proposed project site lies within a secondary vegetation which has been greatly impacted by agricultural activities, hunting and wood for local housing. However, vegetation along the Yando River, which is intended to be used for the dam is almost still intact.

South of the ruined power house runs the secondary vegetation composed of climbers, thick undergrowth and scattered tree species like the Ceiba pentandra, Lophira alata, Lovoa trichiliodes, Nauclea diderrichii, Piptadeniastrum africanum. West of the power house is a reddish brown literate clay hill about 408m covered with tall grasses. Northwest of the power house runs another secondary vegetation running east to a flowing river(Yando River) The river is overshadowed by climbers and young bushes. A number of buttressed plants can be found growing on the trunks and limbs of trees. The under storey is covered with shrubs and herbs.

5.2.1.1 Fishes

The three towns assessed were surveyed on the basic of fish seen and caught in rivers. Survey investigation from the fish survey was conducted by collecting information from residents within these various towns/ villages. Reports collected shows that the locals carry on very small scale fishing activities using hook lines and baskets. Anecdotal evidences from several residents in the area indicate that in the dry weather more fishes are seen since the water flow is reduced considerably and fishes either move to lower ground or are stranded in shallow narrow pools. The survey record of fishes in the project area is indicated below:
Table 1: Fish Survey record

<table>
<thead>
<tr>
<th>Fishes</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malapterurus electricus</td>
<td>Electric catfish</td>
</tr>
<tr>
<td>Schilbe mystus</td>
<td>African butter catfish</td>
</tr>
<tr>
<td>Distichodus rostratus</td>
<td>Grass-eater</td>
</tr>
<tr>
<td>Clarias laeviceps laeviceps</td>
<td>Catfish</td>
</tr>
<tr>
<td>Tilapia zillii</td>
<td>Redbelly tilapia</td>
</tr>
<tr>
<td>Brycinus nurse</td>
<td>Nurse tetra</td>
</tr>
<tr>
<td>Sarotherodon melanotheron melanotheron</td>
<td>Blackchin tilapia</td>
</tr>
</tbody>
</table>

Method: Reported by villagers

5.2.1.2 Terrestrial Resources

Terrestrial resources were also surveyed during the study. The survey focused mainly on the project site and nearby areas. Weather conditions recorded during the survey period were generally dry. The activities of the many hunters and farmers in the area have some effect on the biota present in the area.

5.2.1.2.1 Vegetation

In West Africa, there is a strong rainfall gradient. This led to a distinct zonation of the vegetation. Along the precipitation gradient, the vegetation changes from wet evergreen, to moist evergreen, moist semi deciduous and dry semi deciduous. The Project area has been associated with prolonged anthropogenic activities associated with shifting cultivation (farming). These activities have a strong influence on the existing vegetation in the area. There are scattered secondary forest patches along the area. There are evidences that a succession of vegetation communities occurs in the disturbed areas, with vegetative cover initially being reinstated by pioneer shrubs, followed by the proliferation of large pioneer grass types, such as *Paspalum scrobiculatum* and *Leersia Hexandra*. Ferns, including the creeping and scented fern, *Gleichenia polypodiodes* and *Mohria caffrorum*, are also important pioneering species that follow soon after the ground has been substantially covered by pioneering grass types. The floral survey, which was conducted via field observation, identified several wild leaves, flowers, twigs and fruits. The list of timber species and native grasses identified during the floral survey in the project area is indicated below:
Table 2: Floral survey record

<table>
<thead>
<tr>
<th>GRASSES</th>
<th></th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperata cylindrica</td>
<td>cottonwool grass</td>
<td></td>
</tr>
<tr>
<td>Pteris vittata</td>
<td>Ladderbrake</td>
<td></td>
</tr>
<tr>
<td>Lenzites elegans</td>
<td>edible bracket</td>
<td></td>
</tr>
<tr>
<td>Gleichenia polypodiodes</td>
<td>Creeping fern</td>
<td></td>
</tr>
<tr>
<td>Mohria caffrorum</td>
<td>scented fern</td>
<td></td>
</tr>
<tr>
<td>TREES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Name</td>
<td>Common Name</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Ceiba pentandra</td>
<td>cotton tree</td>
<td></td>
</tr>
<tr>
<td>Lophira alata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piptadeniastrum africanum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nauclea diderrichii</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lova trichilioides</td>
<td>Lova</td>
<td></td>
</tr>
<tr>
<td>Tetraberlinia tubmaniana</td>
<td>Tetra</td>
<td></td>
</tr>
<tr>
<td>Terminalia ivorensis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khaya ivorensis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erythrophleum spp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entandrophragma angolens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guarea cedrata</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Plants of medicinal value to the local population that were recorded during the survey include the following:

<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>LOCAL USAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christmas bush</td>
<td>Cough medicine</td>
</tr>
<tr>
<td>Gana gana</td>
<td>Endurance in males during sex, also use in local alcoholic berverage to clear malaria.</td>
</tr>
</tbody>
</table>

5.2.1.2.2 Wildlife

The results of the wildlife survey in the area shows that fauna population and diversity was less than expected. This is due to consistent shifting cultivation and hunting practices. This statement is specifically true for large mammal species. Wildlife recorded in the project areas can be classified in the following categories:

Invertebrates
Invertebrates recorded during the assessment were moths, butterflies, ants, beetles, and mosquitoes. Other Arthropods were seen including the millipede and the centipede. Anecdotal evidence from residents indicates that many invertebrates exist in the area.
Herpetofauna

The herpetofauna were assessed into two division: Amphibian (Spring frog, Toad frog), Reptiles (Lizard -brown/green, Cassava snake, Black snake)

These animals are found both on land as well as in water, and representatives were noticed during the survey. Anecdotes by residents attest to a rich population of herpetofaunal species in the area. A few small sized lizards were encountered on the site grounds. Tadpoles were not seen but it is expected they do occur in season. The specimens seen were crawling across trails or on trees, basking in the sun, feeding or hopping away.

Birds

During the survey within the project terrain, residents within project localities were also interviewed on the type of birds species found within their areas. The residents were able to record several bird species within the project area with the help of a field guide used by the team during the study. Birds were observed at forest canopies along the edges of the river, in forested vegetation toward Dangalahun 1 and on low lying native grasses as well as the floor of the project area. Bird species recorded in the project area are indicated below:

Table 3: Survey Record of Bird Species

<table>
<thead>
<tr>
<th>Birds</th>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chrysococcyx caprius</td>
<td>Didric Cuckoo</td>
<td></td>
</tr>
<tr>
<td>Francolinus bicalcaratus</td>
<td>Double-spurred Fancolin</td>
<td></td>
</tr>
<tr>
<td>Corvus albus</td>
<td>Pied Crow</td>
<td></td>
</tr>
<tr>
<td>Campethera nivosa</td>
<td>Buff-spotted Woodpecker</td>
<td></td>
</tr>
<tr>
<td>Merops gularis</td>
<td>Black Bee eater</td>
<td></td>
</tr>
<tr>
<td>Apus affinis</td>
<td>Little African Swift</td>
<td></td>
</tr>
<tr>
<td>Streptopelia decipiens</td>
<td>Mourning Dove</td>
<td></td>
</tr>
<tr>
<td>Tutur afer</td>
<td>Red-bellied wood Dove</td>
<td></td>
</tr>
<tr>
<td>Anthreptes collaris</td>
<td>collard sunbird</td>
<td></td>
</tr>
<tr>
<td>Halcyon malimbica</td>
<td>Blue breasted Kingfisher</td>
<td></td>
</tr>
<tr>
<td>Camaroptera brachyuran bravicaudata</td>
<td>Grey-backed Camaroptera</td>
<td></td>
</tr>
<tr>
<td>Method: Observed alive, sound</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mammals

Information was gathered on a mammalian species identified during the survey. They were either heard of by the researchers, observed (dead/alive) or their tracks were observed especially early in the mornings. The unmistakable calls of some of these latter mammals were seldom heard in the area. Additionally, second hand information gathered from the local population form the
basis of the survey, as well as observation of their foot tracks, fecal droppings and killed bush meat observed in the market and project communities. Data collected on mammals were noted and recorded in data sheets, which are listed below:

Table 4: Survey record of mammals

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thryonomys swinderianus</td>
<td>Cane rat/Grasscutter</td>
</tr>
<tr>
<td>Cephalophus niger</td>
<td>Black Duiker</td>
</tr>
<tr>
<td>Epixerus erythropus</td>
<td>Ground Squirrel</td>
</tr>
<tr>
<td>Neotragus pygmaeus</td>
<td>Royal Duiker</td>
</tr>
<tr>
<td>Tragelaphus scriptus</td>
<td>Bush Buck</td>
</tr>
<tr>
<td>Dendrohyrax arboreus</td>
<td>Tree Hyrax</td>
</tr>
<tr>
<td>Hyemoschus aquaticus</td>
<td>Water chevrotain</td>
</tr>
<tr>
<td>Neotragus pygmaeus</td>
<td>Royal Antelope</td>
</tr>
<tr>
<td>Cephalophus Niger</td>
<td>Black Duiker</td>
</tr>
</tbody>
</table>

Method: Observed dead or alive, tracks, faeces seen, reported by villagers

Protected Species

The Forestry Development Authority protected species field guide was used by the team to investigate whether any species of protective status exist within the project area. Interviews conducted with several hunters found out that the project area had since been massively used for hunting activities leaving the area scarce of large animals. The team discovered absolutely no protected species. However, reports were received from the hunters on the existence of three protected animals: Water chevrotain (*Hyemoschus aquaticus*), Royal Antelope (*Neotragus pygmaeus*) and Black Duiker (*Cephalophus Niger*). With respect to the IUCN Red List, these species are of least concern.

5.3 Physical Environment

5.3.1 Topography

The area of the project is comprised of undulating hills and steep slopes ranging up to 50°. There are intermittent valleys between these hills. The vegetation on the site comprises of semi primary and secondary growth. A number of buttressed plants can be found growing on the trunks and limbs of trees. The under storey is covered with shrubs, herbs and a large number of ferns.

5.3.2 Geology

The geology of the area is constituted by rocks of the Liberian Age province. These are predominantly highly foliated granitic gneisses that exhibits a regional foliation and structural
alignment in a northeasterly direction. Within this area there are metasidimentary rocks, such as quartzites, amphibolites, pelitic schists and banded ironstones technically called itabarite.

5.3.3 Climate and Air Quality

The climate in the project area can be characterized as either wet or dry, depending on the prevailing precipitation. The rainy season extends from April through October, with ±90% of the rainfall occurring between mid-April and mid-October. The dry season extends from mid October to mid April. The humidity is low during the day and increasing slightly as the temperature cools at night. A relative humidity of 90% to 100% is common during the rainy season. During the dry season it decreases between 80% and 85%. In March and February the driest period of the year, relative air humidity decreases to as low as 65%. Total wind speed is greatest in the rainy season and lowest in the dry season. The climate of the area can be described as tropical, experiencing warm dry seasons and cold wet season.

See Annex 6 for site specific climate data collected during the EIA for rainfall, temperature, relative humidity and pressure.

5.3.3.1 Rainfall

The effect of climate change in and around the country is visible even in most part of the project areas. There was no rainfall recorded during the assessment. The months of July and August which are the heaviest rainfall months continue to have unstable rainfall. Notwithstanding, during these months, the rainfall is at the range of 2000 to 4000 mm/year. The average rainfall recorded per year in Liberia is put at 2372mm/year.

5.3.3.2 Temperature

Due to the high and low pressure belts and the influence of the Atlantic Ocean, the project area has a fairly warm temperature with a range of 27° to 38° Celsius during the day and 21° to 24° Celsius at night.

5.3.3.3 Relative humidity

In Liberia, the relative air humidity is very high, standing at 90% to 100%. During the dry season it stands from 80% to 85%. During the assessment, the relative outdoor humidity within the immediate project locality was recorded between 42%-93%.

5.3.3.4 Ambient Air Quality

Ambient air quality is generally good. The air quality in the project area can be classified as good owning to the fact that the project is situated in forested vegetation and there are no industrial
pollution sources in the vicinity of the Project, and the transportation density is absolutely negligible. There are no direct sources of gaseous or particulate emissions currently in the project area except from local traffic along the main road and quite a few movement of NGO 4x4 WD vehicles in project communities far from the immediate site of the project. As a consequence of the geography of Liberia, the area is also subjected to the influence of the dust-laden harmattan winds. This seasonal particulate pollution occurs principally during the three months of the dry season, from December to February. Wind speed is greatest during the rainy season and lowest in the dry season.

5.3.4 Surface Water Quality

The Yando River is the largest water body that drains the project area. The river flows northwest of Dangalahun 2, west of Yandohun and runs south east of Dangalahun 1. Several parts of the river are composed of boulders of granites. In fact, the area earmarked for the dam is a long cover of flat granite projected from beneath the river and curving to allow the water flow with uniform velocity. The Yando River is a tributary to the Maigovi River. The Maigovi River joins the Moa River which forms a tributary to the Mankona River. The Mankonna River forms the boundary between Liberia and Sierra Leone. The usage of the surface water will be based on the World Bank Operations Principle on International Waterways

Samples were recorded from the Yando River to ascertain the baseline condition prior to the commencement of the proposed project. Samples were collected and recorded from upstream and downstream of the river. In order to avoid contamination of samples collected, on site testing were done and recorded. The samples collected and the surface water chosen were from these two locations on the water body in order to present unique characteristics of the baseline water quality prior to the daming of the river. The result of these analyses is recorded in the below:

Table 5: Surface Water Sampling Data (Yando River)

<table>
<thead>
<tr>
<th>Water Sample</th>
<th>UTM</th>
<th>Date Sample</th>
<th>Time</th>
<th>pH</th>
<th>Temp. °C</th>
<th>Turbidity (m g/l)</th>
<th>TDSPpm</th>
<th>Con. d. µs</th>
<th>Tot. Alkalinity PPM (mg/l)</th>
<th>Free Cl. PPM (mg/l)</th>
<th>Tot. Cl. PPM (mg/l)</th>
<th>Tot. Hardness PPM (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yando River (Upstream)</td>
<td>0351234/0897854</td>
<td>02/27/10</td>
<td>8:05</td>
<td>5.9</td>
<td>26.4</td>
<td>104</td>
<td>20.9</td>
<td>0.00</td>
<td>20</td>
<td>0.6</td>
<td>0.3</td>
<td>Very soft</td>
</tr>
<tr>
<td>Yando River (Downstream)</td>
<td>0351351/0898147</td>
<td>01/06/10</td>
<td>11:13</td>
<td>6.1</td>
<td>26.2</td>
<td>102</td>
<td>21.4</td>
<td>0.00</td>
<td>40</td>
<td>0.4</td>
<td>0.5</td>
<td>Very soft</td>
</tr>
</tbody>
</table>

Sampling Equipment/Material: Multi-Parameter PCSTestr\textsuperscript{TM} 35, Water Works\textsuperscript{TM} Water Quality Test Strips
Results of Surface Water Analysis

The results of the Physico-Chemical analysis show that the quality of water is typical of that which is usually found in the wet tropical regions of Liberia. In general, the water in the project area exhibits a low conductivity (0.001 µs) have a pH acidic to near neutral (6.2 to 6.9) with a mean of 6.8, which falls within EPA guidelines of 6.5-8.5 for water quality. The water hardness is generally very soft (0-0.5 PPM (mg/L)). The Total Chlorine and free Chlorine contents are also very low ranging from 0.3-0.6 PPM (mg/L). It also shows a low alkalinity with a maximum of 40 PPM (mg/L). The water contain suspended solids of up to 21.4 mg/l, slightly higher than the World Health Organization (WHO) maximum of 20mg/l.

5.3.5 Noise, Odor and Dust

The main economic activities in the site vicinity are subsistence farming. These operations are largely serviced by foot. The passage of vehicular traffic in the area is associated with commercial transport. No other activity occurs in the Project area. Consequently only transient noise currently emanate in the site vicinity, the noise is however not audible over most of the area proposed for development. There are no odors or much dust associated with the activities for which the site is currently utilized.

*Noise measurements recorded in the Project area (taken in 2010 during site assessment between Lo=30-100dB)*

Table 6: Noise data

<table>
<thead>
<tr>
<th>Sampling site Noise dBA</th>
<th>GPS Coordinates</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52.3(Max.)</td>
<td>0351351/0898147</td>
<td>Power house(downstream)</td>
</tr>
<tr>
<td>48.2(Max.)</td>
<td>0351234/0897857</td>
<td>Dam site (upstream)</td>
</tr>
</tbody>
</table>

5.3.6 Soil Environment

The soil type is a mixture of lithosols and some laterite, which is reddish brown in color containing aluminum iron, oxides, acid and low in nitrogen concentration; swamp soil occurring in swampy areas, high concentration of humus with layers consisting of biodegradable materials; and alluvial soil with a high nutrient concentration. Intensive subsistence farming for commercial agricultural activities and food crops couple with other human activities have greatly influenced the nature of the soils resulting in nutrient depletion, soil erosion, iron pan formation and land degradation.
5.4 Human Environment

5.4.1 Land Use

A large proportion of the land-use in and around the study area is farming/shifting agriculture (rice, eddoes, plantain vegetable cultivation). Most of the land that is not under cultivation is highly disturbed secondary vegetation. However, there are indications of small patches of primary and semi-primary forest in the area.

5.4.2 Socioeconomic Conditions

Three (3) villages were surveyed in and around the proposed project area. The villagers’ primary source of survival is subsistence farming (90-95%). The villagers in the area belong to mainly to the Gbandi tribe. Many of the villagers also speak English. Residents in the area belong to both the Muslim and Christian religions, with Muslims highly dominating Agriculture accounts for almost 95% of the labor force within the Project Area. The remaining 15% are those involved in hunting and petty trade. This reflects the agrarian nature of the local economy. Most of the road networks in the Project Area are feeder roads that are in extremely poor condition, especially during rainy season. Consequently, transportation of food crops to the market centers is very difficult and expensive. These conditions, couple with lack of storage and preservation facilities, are major impediments to increased agricultural production.

The Yandohun micro-managed hydro project is accessible by a primary motor road that leads from Monrovia to Gbarnga up to Voinjama and to Kolahun.

There are currently no health facilities in the Project Area. There are however, stalls built to sell medication and a number of persons with little knowledge in health care who administer drugs to people mostly for malaria, diarrhea, common cold and wounds.

Sources of drinking water in the Project Area are particularly similar to other rural areas, i.e. Drill hole, streams and hand-dug wells. In number terms, educational infrastructure could be considered very inadequate with only the town of Yandohun having a primary institution. In general, however, school facility present is not up to acceptable standards. Facilities like furniture and equipment are totally inadequate. Even in the District Headquarter (Kolahun) and the Administrative Headquarters (Voinjama), libraries, staff accommodation, transport, offices are generally in poor condition.

The day to day business activities of these villages are conducted by a village council headed by the Town Chiefs. The council conducts preliminary investigations of criminal and civil matters. Serious matters are referred to police and courts for action. There are quite a number of public utilities such as drinking water, sanitation etc, which are either inadequate or in dire need of rehabilitation. The average citizen lives below the poverty line with less than US1.00 per day.
Information on general socio economic conditions in the project area was gathered from town hearing/meeting. See Annex 3.

Table 7: Infrastructure in the Project Communities

<table>
<thead>
<tr>
<th>Town</th>
<th>Clinic</th>
<th>School</th>
<th>Access to road</th>
<th>Latrine</th>
<th>Pump</th>
<th>Historic sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yandohun</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dangalanhun 1</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Dangalanhun 2</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

5.4.2.1 Administration

The Yandohun micro-hydro project is expected to serve two other villages. The project is also expected to benefit a number of other towns as the project progress. The superintendent runs the daily affairs of the county assisted by other local officials. Administrative control of villages surrounding the project area is maintained by Town chiefs; See below administrative structure:

Figure 6: Flow Chart of Local Administration

Those listed above are responsible for the governance of villages around the project area. The Superintendent is appointed by the President of Liberia along with the Development
Superintendent and Commissioners. The Paramount chiefs, Clan Chiefs and Town chiefs are elected by the people in keeping with the laws of Liberia

5.4.2.2 Social Infrastructure

5.4.2.2.1 Communication

In the administrative headquarters of the county, Voinjama, there is access to a community radio (FM) station which relay news and programs from the United Nations Mission in Liberia (UNMIL) radio and Liberia’s only national radio station, ELBC. This station provides access to information about news and development activities around the country in the project area. Telecommunication services are almost absent in the project area. In order for residents to communicate by cell phones they climb on hill tops to access cell phone signal, because there are no communication towers in the area.

5.4.2.2.2 Utilities

Public utilities like administrative building hosting the county’s superintendent, court house, police station and other recreational building are visible in the administrative headquarters of Voinjama. In the project area and surrounding towns, there is absolutely no visible public utilities except for few hand pumps constructed by nongovernmental organization. Some towns have mud structures in which residents of the town converge to have meetings and other town hall activities. The town of Yandohun, however, has a concrete structure roofed with metal sheet that was constructed through community self help initiative. This facility presently serves as town hall where community meetings are held. It is also used as a court hall and administrative building. The other two towns of Dangalahun 1 and Dangalahun 2 have absolutely no public facilities.

5.4.2.3 Cost Of Living Issues

Cost of living was observed to be very high in the area, as indicated by many of the residents covered during the socio-economic survey. Below is a random sampling list of basic commodities assessed in and around project setting.

Table 8: Price List of basic commodities

<table>
<thead>
<tr>
<th>Item</th>
<th>UNIT</th>
<th>Unit Price in L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Cup</td>
<td>15.00</td>
</tr>
<tr>
<td>Sugar</td>
<td>Cup</td>
<td>30.00</td>
</tr>
<tr>
<td>Salt</td>
<td>Tie plastic</td>
<td>5.00</td>
</tr>
<tr>
<td>AA Battery</td>
<td>Pair</td>
<td>30.00</td>
</tr>
<tr>
<td>Kerosene</td>
<td>200ml bottle</td>
<td>10.00</td>
</tr>
<tr>
<td>Candle</td>
<td>Pcs</td>
<td>10.00</td>
</tr>
<tr>
<td>Item</td>
<td>Unit</td>
<td>Price</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>Bath Soap</td>
<td>Pc</td>
<td>25.00</td>
</tr>
<tr>
<td>Washing soap</td>
<td>Pc</td>
<td>20.00</td>
</tr>
<tr>
<td>Plantains</td>
<td>Bunch</td>
<td>200.00</td>
</tr>
<tr>
<td>Okra</td>
<td>Pile</td>
<td>5.00</td>
</tr>
<tr>
<td>Pepper</td>
<td>Pile</td>
<td>5.00</td>
</tr>
<tr>
<td>Chicken</td>
<td>Medium size</td>
<td>150.00</td>
</tr>
</tbody>
</table>

The raise in these prices as compared to other areas is due to the lack of ready vehicles to ply routes leading to many towns and villages. Extremely difficult roads and long distances are also the main reasons for the raise in price. The cost of food varies with weather. Costs are higher in the rainy season due to difficult access conditions.

### 5.4.2.4 Cultural and Archaeological Resources

The archaeology, historic resources, and general archeological potential of the area were also taken into consideration during the study. At the end of the assessment, none of the above were found in the project area. Resources of archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), were absence from the project terrain.

The immediate project vicinity was also assessed to investigate the presence of critical habitats which include IUCN Red List Species (fauna and flora) wetlands and riparian management zones. At the end of the study, it was discovered that there were no critically endangered habitat found within and surrounding the project area.

### 5.4.2.5 Traffic

The major mains of transport apart from the few available transport cars that transport market women and vehicles belonging to nongovernmental organization are the motor bikes. Residents of most towns have to result in using bikes to travel from one town to another due to bad road condition and lack of vehicles in the area. The road networks comprise of laterite roads constructed by the Government of Liberia and NGO’s, many of these roads are in critical conditions.
CHAPTER 6.0: IMPACT ASSESSMENT, MITIGATION AND ENHANCEMENT MEASURES

6.1 Physical and Biological Environment

6.1.1 Air

Construction Period. The main impact to air quality during construction will be from increased dust levels from construction machinery and road construction. The construction activity will generate airborne dust as well as NOx, SOx and particulate matter. The air quality impacts will, however, be limited and localized to the project site.

Road dust from transport and wind generated dust from project areas may lead to impacts on crops, animals, villages and houses located nearby. Due to the fact that very few people live close to the construction sites, the impact is considered as limited.

To mitigate dust problems the service roads in the vicinity of permanent houses should be sprayed along with the construction sites, during hot and dry periods at least twice a day. All trucks with construction material should be covered. The traffic on access and service roads should be regulated, in order to minimize the air pollution.

Operational Period. During operation the air pollution is expected to be very limited, and the main source will be vehicle emissions and dust from traffic on unpaved roads. In addition there might be some dust from construction sites before they are properly revegetated.

6.1.2 Noise

Construction Period. During construction, noise will be generated from vehicular movements, sand and aggregate processing, concrete mixing, and construction noise. Noise levels in the construction area from machinery and vehicles are estimated to be from 80 to 95 dBA at a distance of 15 m which is higher than the tolerable threshold of 72dBA. Due to very few people living near the construction sites, impacts from the estimated noise levels is assessed to be at a low level.

Noise disturbance will be experienced by the people living in Dangalahun 1 and Dangalahun 2, due to increase in traffic from transport of goods and workers. The main potential impact of high noise levels will be on construction workers. Mitigation measures for noise impacts on construction workers will include standard occupational health and safety practices such as ear protection and enforcement of exposure duration restrictions.

Operational Period. During operation, noise will mainly be generated in the power station. Noise reduction measures will be taken, where required to reduce the noise levels. Mitigation measures for noise impacts on workers will include standard occupational health and safety practices such as ear protection.
6.1.3 Soil

6.1.3.1 Construction Period

Soil will be impacted due to (i) loss of topsoil, (ii) failure to refill and re-vegetate borrow areas and temporarily used land, (iii) erosion, (iv) soil contamination by products used for the Project, and (v) failure to re-utilize displaced earth during the construction period. As much of the land cover of the Project has grass and shrub vegetation and is on slopes it is prone to erosion and soil-slides. All top soil will be scraped off while preparing project areas (including during scaling and planning of surfaces) and stored for re-use in rehabilitating temporary acquired land and spoil areas. Disposal areas will be well marked and monitored so that appropriate procedures for disposal of different agents and waste materials are followed to minimize soil contamination.

In all cases erosion can be minimized by regular rehabilitation of areas not in use for Project activities during construction. Rehabilitation will include (i) allowing immediate revegetation for keeping soil in place) of slopes to minimize erosion, (ii) use of top soil removed and stockpiled from Project areas, (iii) installation of sediment runoff control devices, (iv) erosion and revegetation success monitoring. Soil erosion and siltation will be minimized by preventive measures and appropriately engineered storm water diversion, on a case-by-case basis.

All Project areas will be ‘greened’ by planting of trees and were appropriate shrubs and grasses to reduce erosion during the construction period. Road constructions will potentially lead to erosion which will be minimized by suitable road engineering techniques and road edge buffer re-planting. All excavated rock and aggregate will be used in construction where possible, while the spoil will be deposited in an area with minimum landslide potential, multilayered and covered with soil, and planted with trees, shrubs and grasses.

6.1.3.2 Operational Period

During operation, potential impact to soil could occur from spillage of hazardous wastes and materials, including hydrocarbons, and from localized scour at the water outlet. Soil contamination will be prevented by installing oil separators at wash down and refueling areas, and by installing secondary containment at fuel storage sites. All hazardous wastes and hazardous materials will be stored in properly designed storage facilities.

6.1.4 Water Quality

6.1.4.1 Impacts in the Construction Phase

In this phase the water flow will be temporarily obstructed during rehabilitation of the dam, the river will still be passable for fish. There will be limited upstream impacts during this period. During the construction phase, the following activities can affect the water quality and aquatic life negatively:
• Erosion due to road building, construction work in the dam area, soil deposits, and accidental water releases
• Sedimentation in the slow flowing river stretches, with shallowing of deep pools
• Reduced primary production due to siltation of periphyton producing substrates, as well as due to reduced light penetration of the water column from increased turbidity.
• Sanitary effluents from the construction workers in the area
• Oil spills
• Temperature effects are not expected
• Dry-ups during filling the forebay tank

6.1.4.2 Impacts in the Operation Phase

Downstream of the dam

In the first years after the dam becomes functional there will be a lot of erosion taking place in the earth channel leading to the forebay tank, and the silt and clay fraction of this erosion material will also impact the river downstream. This impact will disappear after 3-5 years.

The diurnal flow and water level variations will be large downstream of the power plant. Such variations may cause erosion.

The erosion from the land will also increase in general due to increased human activity in the area, more erosion prone roadsides, deforestation, agricultural land, excavating, etc.

It may happen that the forebay tank, in shorter periods, has to discharge large amounts of water through the spillway. Such events might cause erosion in the downstream river. In the downstream 5 km stretch between the dam and the outlet from the power plant, the flow will be very low and the water susceptible to pollution discharges on the stretch. The forebay tank will retain coliform bacteria from the upstream, and will also retain sediment particles after the first initial erosion period is over. The water coming out of the forebay tank will thus be clearer than the water entering the forebay tank. In the first 2-3 years after the dam becomes functional the water coming out of the forebay tank will have low oxygen content due to decomposition of organic material from the inundated terrestrial catchment. This water will also contain high levels of bio-available nutrients for a period of 2-3 years, which will cause some eutrophication impacts downstream. These effects will last only 2-3 years.

The temperature downstream the power plant will be 2-3 degrees lower than it was before, but further downstream it will reach the average air temperature relatively quick, so this is not regarded as a concern.

6.1.4.3 Mitigation Measures during the Construction Phase

Measures against erosion

During the construction phase there are large risks for heavy erosion that will create considerably stress for the river biota, as well as creating problems for human use of the water. Therefore, erosion abatement measures should be taken at all construction sites. Roadsides and other areas
with denuded soils should be sowed by grass, road drainage should be strengthened with appropriate concrete/stone settings, machine parking areas and roads should be compressed with laterite to the extent possible, etc.

Measures against oil spills

The machine park that will be involved in the construction work will include the use of comprehensive amounts of fuels, oils, hydraulic fluid, battery acids, etc. In addition there will be needs for workshops and maintenance areas. The machine parking area, the workshop area, and the fuel and oil filling area should be gathered to one area that should be paved, and equipped with a controllable drainage so that all diffuse spills and accidental spills could be collected at all times.

Measures against sanitary effluents from workers

Toilet water should not be allowed to be discharged into the river, which could cause health hazards for those living downstream.

6.1.4.4 Monitoring

A monitoring programme (see ESMP) should be launched both in the construction phase, and in the operational phase. The monitoring should cover the following items:

- Water quality
- Fish content

6.1.5 Aquatic Ecology

6.1.5.1 Between the Dam and the Discharge point downstream (Regulation Zone)

Impact on aquatic habitats

The inundation will accomplish a loss of river habitat of approximately 100m during the dry season when water level is low. Most life in the littoral zone will die due to the periodical dry ups. Inorganic erosion material will settle in the river bottom and reduce the nutritional value of bottom sediments for the bottom dwelling animals. In the first years after the regulation the fish productivity will be relatively good because of food and nutrients from the inundated terrestrial land. Over time fish productivity will be markedly reduced, and the potential for fish harvest will be low in this area.

Impact on biodiversity
Only a few fish species will succeed in adapting to life in the regulation zone. In this area the biodiversity of fish will be reduced by 30-50%. However, most of these species will survive in the upstream and downstream part of the river. The creation of the dam will restrict the movement of the long distance migrants along the areas of the watershed. It should be noted that there is no exhaustive survey done on aquatic life, so precise impacts are hard to determine.

6.1.5.2 Mitigation Measures

Measures to keep a good fish productivity in the Regulation Zone
Without a compensation flow this section of the river will be dry for long periods each year. There will be a 100% loss of aquatic life, no drinking water for animals during dry season and increased risk of pollution from human activity. To mitigate this impact, water flow must be maintained in this area at all times, especially during the dry season. This will require limiting the operation of the power station when the water flow is low, especially during the day time of the dry season (December-February). It is roughly estimated that during the dry season, water flow could decrease as low as 0.050\(\text{m}^3/\text{s}\), especially in February. It could likewise increase up to 0.50\(\text{m}^3/\text{s}\) during the wet season. Henceforth, the outlet in the dam area, shown below, that allows water flow to downstream stretches should be monitored to prevent obstruction so that water flow downstream can be maintained at all times. A minimum of 10% of water flow should be initially maintained during the operation period. After monitoring of some sample of aquatic life, especially fish species, and water quality this figure could be adapted.
6.1.5.3 Monitoring

A monitoring programme should be launched in the operational phase. That is after the dam becomes operational, the forebay tank is filled and the power plant has started its operation. Very shortly, the monitoring should cover both fish yield and fish species composition in the Regulation Zone.

6.1.6 Terrestrial Ecology

6.1.6.1 Flora

As pointed out and shown by field surveys for this ESIA the vegetation cover of the Project areas has been subject to human influence over a long period of time. Subsistence use is the main cause of loss of primary forest. The slash and burn practice which is that of the ethnic group has also had its toll on the forest systems. Overall the value of the forest resources in the Project are poor, and even for local use (timber) it is not of high quality and people resort to logging from higher elevations and better forested areas. Wood for fuel abounds in the area and thus forests and woodlands will be encroached upon for this resource if no alternative fuel resources are available.

More specifically Project areas covering the dam, forebay tank, and power house have very low forest quality and species richness. These areas experienced clearing during the construction of the facility in the 70’s. They have also been cleared recently to make way for the rehabilitation efforts. The areas which have patches of better quality forest and higher plant species numbers are located outside the project perimeter towards the town of Dangalahan 1. Due to the overall plant cover status of the Project Area, which is largely open forest, it is prone to erosion as the soils are not all bound solidly by vegetation. Soil will be exposed and be erosion prone in many locations due to Project activities and this impact will be common across all Project areas.

6.1.6.2 Fauna

Impacts to the terrestrial fauna have been related to the physical clearance of the areas occupied by the penstock, forebay tank and power house areas, and disturbance or degradation of forested ecosystems (mainly workers but also camp followers) and improved access by roads. The later is seen to be more significant due to the relatively poor ecosystems directly lost to the Project and that there are forest resources in the vicinity of the Project Area which are already subject to illegal logging and wildlife hunting.

Forest protection and environment awareness will have to be enhanced to reduce impacts related to an increased worker population and accessibility to forested areas. Regulations will need to be imposed. Based on the current information there appear to be no migration routes that will be blocked by project inundation. Project areas like disposal areas, power station, and transmission lines can impact fauna species but precautions can be taken and thus risks minimized.
6.1.6.3 Potential Impacts specific to Project Area

6.1.6.3.1 Forebay tank, Dam, Power House, Penstock

Habitat loss and fragmentation are direct effects of the penstock, power house, dam and the forebay tank that is created. However, habitats may also be lost as a result of the induced activities related to forest clearance and change, isolation of habitats, and the creation of assess. The rehabilitation of the weir/dam has the potential to slightly impact on in-stream migration downward due to increase in the turbidity of the water resulting from rehabilitation work at the weir. This is however, insignificant due to the height between the weir and the power house.

Noise and vibration from Project activities may also disturb some wildlife species living along the river. Most of these impacts have already been created in the construction and maintenance of these facilities.

However the fauna in the penstock, power house, dam and forebay tank area is not rich or unique primarily due to the quality of habitat and most of the species are common with wide distributions. In other words none of these species are restricted to areas with specific ecological conditions. Most of larger size species were able to move out from the area. A number of small animals (e.g. some rodents and small lizards) will be lost if they do not have the rapid mobility required to escape from forest clearance. Since there are no exhaustive long term surveys completed on flora and fauna species in these areas precise species loss and impacts are not quantifiable.

6.1.6.3.2 Construction Areas and Roads

Forest Clearance and Creating access to the forests. Easy access to the forest in the area will be created as a result of the rehabilitation of access roads to the power house, dam and forebay tank. Illegal timber logging and harvesting NTFP activities may increase if enforcement activities for forest protection are not in place. With the rehabilitated access road this area and higher slopes of the mountain are the most vulnerable: becoming highly attractive for illegal logging, hunting and NTFP harvesting. All types of clearance of forest increases erosion vulnerability, fragmentation (in some cases, as mentioned above) and access to nearby forested areas.

Creating high demand for firewood, timber and NTFPs. The demand for firewood and timber will increase due to increased energy requirements for cooking for both workers, camp followers, and other incoming households and restaurants. Using timber for house construction both in working camps and service area may also be increased. Creating options for non-timber/wood use cooking and heating options may be important in helping reduce the pressure of firewood and timber. Exploitation of forest vegetables, fruits and medicinal plants will increase to meet the demand for NTFPs in the area during the construction period.

Disturbance and Noise to Wildlife. Disturbance of wildlife communities from the increased
activity resulting from the power house, dam and forebay tank rehabilitation, whether it comes in the form of noise or increased access by people can be a form of stress upon the populations particularly if they are sensitive species. The following changes in behavior may result: avoidance of the most disturbed area, changes in feeding pattern, increased susceptibility to predation as a result of stress and loss of condition, and changes in breeding patterns. During the construction period, the general level of noise in the project area will increase considerably. The noise will be derived from following sources: 1) earth moving equipment 2) construction traffic. Noise in construction area. Large animals will move away from working area and may be caught by hunters while actively moving away.

**Siltation.** Soil borrowing, work in auxiliary areas, dam site, power house and road rehabilitation will result in erosion and siltation through the weakening of slopes and exposure of soil.

**Pollution.** Hazardous material from machines and solid and liquid waste can impact soil and water quality. It will be necessary to have an appropriate sewage and waste treatment system and disposal sites for solid waste in the Project Area. Polluted water can have adverse affects on riparian vegetation and aquatic fauna.

**Electrocution.** The powerhouse area will be exposed to construction activities and also experience habitat destruction and alteration as will most of the areas under construction. These can create problems to wildlife and to birds in particular. Switchyard and sub-station areas in general are disposed to electrocution problems like those found in connection to transmission and distribution lines.

### 6.1.6.3.3 Transmission lines

**Forest clearance**
A transmission line of 4.6 km and 11 kV will connect the power station to the substation. The impacts of the line are related to habitat loss, fragmentation and creating access to the forest. The construction and maintenance of transmission line rights-of-way, especially those aligned through forested areas, may result in alteration and disruption to terrestrial habitat, including impacts to avian species and an increased risk of forest fires.

**Habitat isolation**
The transmission line and its corridor will increase disturbance and fragmentation. Habitat isolation and additional impacts from construction activities at the dam site, power house, service road, and auxiliary areas, will impact biodiversity (e.g., access, dispersal of species, pollination) The immediate project vicinity was also assessed to investigate the presence of critical habitats which include IUCN Red List Species (fauna and flora) wetlands and riparian management zones. At the end of the study, it was discovered that there were no critically endangered habitat found within and surrounding the project area.

**Creating access to the forests.** The maintenance of transmission lines will also create easy pathway conditions for people to enter the forest. Timber trees and plants yielding NTFPs will be
at risk because of potential in increased illegal logging, hunting and harvesting of NTFPs. Steadily increasing environmental stress has made mortality factors to birds and animals more important than that once considered insignificant. Clear-felled power line corridors in the forested areas can have far reaching fragmentation and habitat changing effects that might affect fauna. Habitat fragmentation is identified as one of the main threats to biodiversity. It has been stressed that power-line corridors may be particularly damaging to some groups of species, both terrestrial and birds. Clear-felled areas of up to 40 meters open by forested areas while dissecting contiguous ones. The main problems associated with wildlife and transmission lines are related to (i) electrocution, (ii) bird collisions, and (iii) fragmentation (barrier) effect of the cleared areas and habitat destruction. Note that the building of roads can also have some of the similar impacts.

6.1.6.3.4 Construction Workers Camps and Administration area

A number of the induced impacts of the project will have a more lasting influence upon the populations of flora and fauna than habitat loss and disturbance. Direct mortality of individual species may not be important at a population or overall biodiversity level, providing that the populations are able to withstand the continual off-take. However, if they can not sustain these losses over a longer period the overall populations are at risk, and in this case particular protected species may further decline. Thus certain activities induced by the Project may give rise to a reduction of the overall biodiversity of the area, especially related to overexploitation of forest and land resources. In addition in all cases exploitation of the natural resources will give rise to disturbance, so even if the animals are not killed they will still be disturbed and be increasingly wary of any humans.

Creating high demands for firewood, timber and NTFPs. As with wildlife, demand for firewood and timber will increase due to increased energy requirements for cooking for both workers and other incoming households. Using timber for house construction both in working camps and service area may also be increased. Creating options for nontimber use cooking and heating options may be important in helping reduce the pressure of firewood and timber. Exploitation of forest vegetables (e.g., bamboo shoots) will probably increase to meet the demand for NTFP in the area during the construction period. To meet the demand from markets villagers will be asked to provide forest products, while some workers may go out to collect for their own consumption or sale. Increased opportunities for additional income from NTFPs and ease of access into the area will encourage both local and outside collectors. The collection of plants or plant based NTFPs also encourages smallscale hunting and trapping.

Creating high demand of wildlife use. The demand for wildlife products is high in the project area and its surrounding, and hunting in the forest with traps and dogs is the principal source of supply.

Our field observations indicate that the main customers for bushmeat are businessmen, resident villagers and visitors from outside areas. In this light the increase in workers and visitors to Yandohun and surrounding areas is likely to induce an explosion of demand for wildlife. To meet the demand from markets villagers will be asked to provide wildlife products while some
workers may go out to hunt for their own consumption or sale. Increased opportunities for additional income from hunting and ease of access into the area will encourage local and outside hunters.

**Pollution.** It will be necessary to have an appropriate sewage and waste treatment system and disposal sites for solid waste in the Project Area. It will also be necessary to monitor and control the treatment and disposal during the construction and operation phases for preventing the pollution of Yando River water. Polluted water can have adverse affects on riparian vegetation and aquatic fauna reliant on the water source.
CHAPTER 7.0: SOCIO-ECONOMIC ANALYSIS OF PROJECT IMPACTS

7.1 Socioeconomic Conditions

Three towns involved in the present project arrangement, Yandohun, Dangalahun 1 and Dangalahun 2 area were considered during the socioeconomic impact assessment. These communities, with socio-economic survey data indicated in the table below, are key to the socio condition of the project.

Table 9: Socio-economic Survey Data

<table>
<thead>
<tr>
<th>NO</th>
<th>Settlement</th>
<th>Date Established</th>
<th>Founder</th>
<th>Estimated Population</th>
<th>Estimated no. of houses</th>
<th>Type of Housing</th>
<th>Existing social/public service</th>
<th>Primary source of income</th>
<th>Source of Energy</th>
<th>Monthly H/H energy cost IN Liberian Dollars</th>
<th>Land Tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YANDOHUN</td>
<td>EARLY 1904</td>
<td>OLDMAN KARLEE</td>
<td>2500-3000</td>
<td>180</td>
<td>zinc with mud brick thatch house</td>
<td>church, mosque, townhall, hand pump, football field</td>
<td>farming, petty trade</td>
<td>kerosene lamp, oil lamp, flash light, firewood</td>
<td>150-310</td>
<td>tribal</td>
</tr>
<tr>
<td>2</td>
<td>DANGLAHUN 1</td>
<td>2007</td>
<td>MOMO GAYZAH</td>
<td>70-100</td>
<td>11</td>
<td>thatch house</td>
<td>none</td>
<td>farming</td>
<td>oil lamp</td>
<td>75-150</td>
<td>tribal</td>
</tr>
<tr>
<td>3</td>
<td>DANGLAHUN 2</td>
<td>LATE 1920</td>
<td>MANAH KAMARA</td>
<td>100-150</td>
<td>15</td>
<td>thatch house</td>
<td>none</td>
<td>farming</td>
<td>oil lamp</td>
<td>50-100</td>
<td>tribal</td>
</tr>
</tbody>
</table>

Other stakeholders including the county authorities were also consulted. Data collected from the field were collated and systematically analyzed. The interviews and meetings were intended to identify current and projected impacts on socio-economic conditions resulting from the Project. The meeting format consisted of four distinct sections. These sections covered the following:

- Social status of the community
- Association with the area and perceptions of the Project
- Needs of the community
- Proposals to mitigate Project impacts

The three project communities and other adjacent communities have a high degree of awareness about the project.
In all of the communities surveyed, the residents show their interest in the project and expressed the desire to work in the area of skilled and unskilled work that is available, as part of their contribution for the development of the project. The communities are convinced based on their past experience with the project that, it will improve their livelihood and provide incentive for socio economic boom within the area. The creation of electricity supply may result in improved education standards and services in the communities. Social unrest and other conflicts may arise. The introduction of modern oil palm agriculture techniques and equipment means that the project will introduce new technology to the area. The completion of major roadways connecting project communities may result in increased land values in the communities in close proximity to the Project.

The influx of people in the community from surrounding areas would be surrounding residents desperately searching for improved living conditions created within the project communities. This can serve to disrupt social cohesion existing within communities due to pressure on existing resources such as land, water and housing. In communities where cultural norms and values are still treasured, the new comers may not conform to the status quo. This could be an incentive for conflict within the communities. Residents may alter their lifestyles after exposure to culture and lifestyles introduced by new settlers, from areas remote to the communities in the Project area. As more residents seek improved conditions in project communities, they may move away from traditional farming practices. If most of these traditional farming and food gathering practices are abandoned, residents may develop a dependence on trade and other opportunities to provide for their families and their existence may be determined by their spending power.

Social interaction with other groups has the potential to bring about an increase in alcohol, drug abuse, prostitution and crime. The circulation of money from wages and salaries would sustain some of the construction workers leisure activities. This may increase the demand for sexual services especially for those foreign workers. In the long term, this may bring about an increase in sexually transmitted diseases. There is also a potential risk of increase HIV/Aids. However, with the existing lifestyles, culture, religion and tradition of the host community such vices are not likely to gain prominence. Long term mitigation measures to address these situations will include the establishment of a local court and police presence in the area by the local government. This will further enhance local governance and maintain law and order.

Based on the positive contribution to local energy supply the impact of the project is considered to have long term and major significance. As for the loss of land, the impact of the project on land is considered to be of low significance since there is abundance of land within the area for housing, agriculture and other purpose.
7.1.2 Economic Benefits

The project will provide short term, medium and long term positive economic benefits for the project villages and surrounding areas. Electric power generated from the micro-hydro plant will provide electricity for more than 200 households with a population of more than 2000 residents at affordable cost. This will reduce household energy expenditure (kerosene, candle, palm oil lamb, flash light and battery). The extra money saved from the energy expenditure can be used to service other vital needs of the residents such as healthcare, food, education, clothing etc. Additionally, the project will serve as an incentive for boost in micro-enterprise development for the following businesses: video clubs, cell phone charging booths, general merchandise etc. The establishment of rice and other agro processing and storage facilities, food preservation in the medium to long term will also be a major boost to poverty reduction and food security.

7.1.3 Payment of fees for supply of Electricity

The project will require local residents to pay fees for the supply of electricity to their homes and businesses. The fees will be used to pay for personnel and maintenance costs for the operation of the plant. There is no clear picture at this point on what the fees structure will look like. A survey of household expenditure on energy, specifically lighting at night using mainly kerosene, flash light, palm oil lamp and candle shows that the residents spend between 50-310 Liberian Dollars per room for energy on a monthly basis. With the majority of the population living on less than USD1.00 (70.00 LD) per day it is quite clear that many may not be able to afford the cost for electricity supply if it were high. Asked how much they can afford to pay for electricity fees on a monthly basis, the following chart demonstrates the responses generated from 110 persons surveyed in the three villages.
Figure 7: Chart of what residents can afford to pay per bulb of light in a month

The results show that 32% constituting majority of those surveyed are willing to pay LD$10.00 per light bulb as fees for electricity on a monthly basis. 5% of the respondents indicated that they cannot afford to pay fees, while 7% indicated that they can only determine how much they can afford to pay when after they have received the electricity. 16% said they do not know how much they can pay at this point in time but they are willing to pay a reasonable cost. 7% can pay LD100.00, 17% can pay LD20.00 and 16% can pay LD50.00.

Against this background, an agreement needs to be reached between the project proponent and the host communities in order to reach an acceptable consensus on the amount household residents will be required to pay as service charge for the supply of electricity to the households. If such a decision is not made it could undermine the sustainability of the project thereby resulting in its failure. There is also a potential for conflict between the community-based power
management team and the community residents if a clear cut agreement is not reached on the fees for electricity supply.

7.1.4 Noise, Odor and Dust

Dust emissions would be produced during the construction and operation by vehicles using the site roads.

Noise levels above the alert threshold of 86 decibels and hazard threshold of 95 decibels will be produced from heavy-duty machines operation. During maintenance operations vehicles in maintenance workshops usually generate noise levels in the vicinity of 72-110 decibels. Exposure to noise levels above the internationally accepted level of 90 decibels can cause noise induced hearing loss. Noise levels above the tolerable threshold of 72 decibels can cause/result in fatigue, tiredness, low morale and decreased production levels and productivity. Tired workers are also prone to accidents and this can contribute to an increase in accidents in the working environment. The power generating plant operation will emit noise. There would have been minimal noise stresses in the project area prior to the project.

The potential impact of intermittent noise on the local environment is considered locally of low significance due to the fact that the active operating zone of the project is far from human settlement. Notwithstanding, mitigation measures would have to be put in place to protect project workers and the nearby residents within the project area.

7.1.5 Cultural and Archaeological Resources

The cultural and archaeological resources are not likely to be affected by the construction or operation of the project given that these are not located within project areas.

7.1.6 Traffic

The Project would enhance the condition of the current roadway leading to the power house. It will also introduce traffic into the area. The need for construction vehicles to pass over the road during the initial phase of the project may result in some rutting. Enhanced road conditions may result in increased speed over this road and will also ensure continued access during wet periods. Speeding may result in increased incidences of vehicular accidents along the roadway. Traffic introduced to service the operations site would include trucks and four wheel drive vehicles.

7.1.7 Impacts of tourism activities

After the hydro station has been constructed and the bulk of workers have left, the demand for NTFPs and wildlife meat may still exist. There will be continuing demands from visitors to the area who may expect and demand NTFPs. This demand is, however, expected to be low.
### 7.1.8 Occupational Health and safety Impacts Power Transmission and Distribution

During the construction, operation, maintenance and decommissioning phases of the project, there will be occupational, health and safety issues that include exposure to physical hazards from use of equipment; trip and fall hazards, exposure to dust and noise, falling objects; work in confined spaces; exposure to hazard materials; and exposure to electrical hazard from the use of tools and machinery. These have been discussed in previous sections. Potential occupational health and safety hazards associated with power transmission and distribution in this project include: live power lines, working at height, electric and magnetic fields.

**Live Power Lines**

Workers may be exposed to occupational hazards from contact with live power lines during construction, maintenance, and operation activities.

**Working at height on poles and structures**

Workers may be exposed to occupational hazards when working at elevation during construction, maintenance, and operation activities

**Electric and magnetic fields**

The operation of the project has the potential to release electro magnetic fields. Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines. However, the expected levels of the EMFs for an 11 kV power line are minimal and do not cause health impacts, because of the low voltage; the higher the voltage, the stronger will be the resultant field.

Electric fields exist whenever a positive or negative electrical charge is present. They exert forces on other charges within the field. The strength of the electric field is measured in volts per metre (V/m). Any electrical wire that is charged will produce an associated electric field. This field exists even when there is no current flowing. The higher the voltage, the stronger the electric field at a given distance from the wire.

Electric fields are strongest close to a charge or charged conductor, and their strength rapidly diminishes with distance from it. Conductors such as metal shield them very effectively. Other materials, such as building materials and trees, provide some shielding capability. Therefore, the electric fields from power lines outside the house are reduced by walls, buildings, and trees. When power lines are buried in the ground, the electric fields at the surface are hardly detectable.

Magnetic fields arise from the motion of electric charges. The strength of the magnetic field is measured in amperes per meter (A/m); more commonly in electromagnetic field research, scientists specify a related quantity, the flux density (in microtesla, μT) instead. In contrast to
electric fields, a magnetic field is only produced once a device is switched on and current flows. The higher the current, the greater the strength of the magnetic field.

Like electric fields, magnetic fields are strongest close to their origin and rapidly decrease at greater distances from the source. Magnetic fields are not blocked by common materials such as the walls of buildings.¹

7.1.9 Community Health and Safety

Potential community health and safety impacts during the construction and decommissioning of transmission and distribution power lines at the project include dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of migrants. The operation of live power distribution lines and substations may generate the following industry-specific impacts:

Electrocution

Hazards most directly related to power transmission and distribution lines and facilities occur as a result of electrocution from direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity.

Electromagnetic interference

The corona of overhead transmission line conductors and high frequency currents of overhead transmission lines may result in the creation of radio noise. Typically, transmission line rights-of-way and conductor bundles are created to ensure radio reception at the outside limits remains normal. However, periods of rain, sleet or freezing rain sharply increases the streaming corona on conductors and may affect radio reception in residential areas near transmission lines.

Visual Intrusion

Power transmission and distribution are necessary to transport energy from power facilities to residential communities, but may cause visual intrusion and undesirable to local residents.

Noise and Ozone

Noise in the form of buzzing or humming can often be heard around transformers or high voltage power lines producing corona. Ozone, a colorless gas with a pungent odor, may also be produced. Neither the noise nor ozone produced by power distribution lines or transformers carries any known health risks. Noise from transmission lines reaches its maximum during

¹ (Extract from Electromagnetic fields published by the WHO Regional Office for Europe in 1999 (Local authorities, health and environment briefing pamphlet series; 32).
periods of precipitation, including rain; the sound of rain typically masks the increase in noise produced by the transmission lines.

Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program. The project should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents.

7.1.10 Resettlement and Compensation

The rehabilitation of distribution and transmission lines will have no direct potential impact on farms and houses within the project area since there are no settlements around the proposed project site or people using the areas directly affected by the project site. Notwithstanding, in the event where the contractor may decide and recommend the construction of a new power house in a location other than the existing one and the subsequent planting of new poles, a preliminary inventory of the people and assets which would be affected by this new location would have to be made, leading to a Resettlement Action Plan.

Effective resettlement planning hinges on meaningful consultations with, and participation by stakeholders and the general public. Stakeholders are all those with a legitimate interest in the resettlement process, and typically include affected peoples, households, communities, traditional and local county authorities, Ministry of Agriculture, Ministry of Lands, Mines & Energy, Ministry of Internal Affairs, Ministry of Finance, Environmental Protection Agency and civil society.

As mentioned earlier, the idea of resettlement and compensation to affected peoples is not envisaged.

As required by international best practice, World Bank Safeguard Policy (Involuntary Resettlement OP4.12), all aspects of the resettlement should be a consultative and participatory process through which affected peoples are consulted properly and choose for themselves from among acceptable and clearly defined alternatives.
CHAPTER 8.0: ENVIRONMENTAL, SOCIAL MANAGEMENT & MONITORING PLAN

8.1 Introduction

This chapter provides information on organizations that will be responsible for the implementation of the mitigation and environmental and social protection and capacity building plan, and monitoring of their implementation. In addition the mitigation measures and their implementation are summarized.

Since mitigation forms a vital part of the Project an Environmental Management Office (EMO) will be established by the Implementing Agency to implement the Environmental & Social Management Plan (ESMP) for the project. Such a team can be headed by an individual responsible for the entire mitigation operation, plus reports on progress and the status of each rehabilitation conducted. Amongst other things the EMO will tasks associated with forest protection, increasing environmental awareness, day to day practical aspects and play a pivotal role in rehabilitation strategies employed. It is suggested that this team and workers be established at the onset of the to identify project-specific mitigation measures, thus updating the EMP.

Management should also include the education of employees and locals in environmental issues. For example, workshops on mitigation should first of all be set up for all mitigation workers with the help of EIA Consultants. Secondly local people should be better informed of mitigation strategies and methods so that they understand the nature of how land and soil loss problems are handled.

Furthermore the importance of controlling grazing and wood collection on revegetated sites must be enforced. All these issues will be covered by an Environmental Awareness Campaign. A monitoring programme for water quality and aquatic life for pre-construction, construction and operation phases is in Annex 5. Environmental Protection training and awareness, and capacity building of institutions are essential elements of the EMP.

8.2 Organization and Implementation.

The Government of Liberia with support from the World Bank is the Executing Agency (EA) for the Project and has the overall responsibility for ensuring that all environmental standards and procedures are followed. The Environmental Protection Agency of Liberia is responsible for implementing and monitoring environmental procedures. The Implementing Agency (IA) during construction will be the Rural and Renewable Energy Agency of the Ministry of Lands, Mines & Energy. Prior to the project construction, the IA will set up an environmental & social management Unit (ESMU) for environmental and social management and operation, including environmental supervision of contractors. The ESMU will ensure implementation of the environmental management plan and the environmental monitoring plan during construction of the Project. The ESMU will be staffed by a project manager and with technical personnel who
should be mainly an engineer. The work of the engineer should be to supervise and ensure quality in the work done by the construction engineer and the adequate implementation of the Constructor Environmental and Social Management Plan (CESMP). During operation the Power Plant Operator, Yandohun Hydropower Project Management (YHPM), will be responsible for the implementation of the ESMP.

Based on this ESMP the contractor carrying out the rehabilitation of the power plant prepares his own construction ESMP, which is called the CESMP. The contractor will be responsible for the implementation of the CESMP. A supervising engineer will be employed to ensure quality. This Supervising Engineer also needs to supervise the adequate implementation of the CESMP.

The IA will ensure that the ESMP is included in all contractor bidding documents and operating contracts. Based on this ESMP, the contractor carrying out the rehabilitation of the power plant will prepare a construction ESMP. The implementation of the CESMP will be the sole responsibility of the constructor.

The ESMU will coordinate all environmental monitoring activities as given in the ESMP. The ESMU will ensure that the ESMP is updated periodically during the construction period. The ESMU will submit environmental monitoring reports (including physical data) to the EA, EPAL, RREA and World Bank twice annually during construction and quarterly, to EPAL for 2 years, after completion of construction.

8.2.1 Capacity Building

The RREA currently has 9 staff. The Capacity Building will include training of personnel in RREA in the areas of environmental protection and management, in addition to those of Representatives of the local communities (YHPM).

8.2.2 The Environmental & Social Management Unit

Under the IA an ESMU will be responsible for the implementation and management of the EMP. The ESMU will be specially designed for the Project and will include three full time staff. Regular environmental, health and safety rounds in the construction area will also be part of the responsibility of the ESMU.

8.3 Management of Impacts: Environmental Management Plan

<table>
<thead>
<tr>
<th>Environmental Impact/issue</th>
<th>Mitigation Measures &amp; Monitoring</th>
<th>Location</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of topsoil</td>
<td>Loss of topsoil will be avoided by stripping and storing topsoil prior to construction and reusing it for rehabilitation.</td>
<td>All construction sites</td>
<td>Contractor/RREA/EPA</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Soil erosion and siltation</td>
<td>Soil erosion and siltation will be minimized by preventive measures and engineered storm water diversion on a case by-case basis. All project areas will be &quot;greened&quot; by planting trees and, where appropriate, shrubs and grasses to reduce erosion during the construction period. Road constructions will potentially lead to erosion, which will be minimized by suitable road engineering techniques and road edge buffer replanting. Parameters to be monitored: erosion status/vulnerability.</td>
<td>All construction sites and access roads</td>
<td></td>
</tr>
<tr>
<td>Soil contamination</td>
<td>Soil contamination will be prevented by installing secondary containment at fuel storage sites. In case of spills, the ESMU will undertake monitoring.</td>
<td>Hydropower plant and material storage areas</td>
<td>Contractor/RREA/EPA</td>
</tr>
<tr>
<td>Disposal of excess earthworks</td>
<td>All excavated rock and aggregate will be used in construction where possible, while the spoil will be deposited in areas with minimum landslide potential; layered and covered with soil; and planted with trees, shrubs, and grasses. Parameters to be monitored: stability and revegetation success of spoil deposited sites.</td>
<td>Disposal areas</td>
<td>Contractor/RREA/EPA</td>
</tr>
<tr>
<td>Water Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposal wastewater</td>
<td>Wastewater discharge during the construction phase will consist of wastewater effluent discharge from the work camps. There will be no direct discharge of untreated sanitary waste to surface water bodies. Truck and other vehicle maintenance will be strictly controlled to prevent discharge of waste oil into the river. Parameters to be monitored: Total coliform, TDS, pH, oil, ensure that standards are upheld</td>
<td>Work camps, construction sites</td>
<td>Contractor/RREA/EPA</td>
</tr>
<tr>
<td>Reduced water quality in Yando River</td>
<td>Contamination of the river from waste, hazardous materials, and soil erosion and contamination will be minimized through mitigation measures connected to these issues. Regular monitoring of water quality at two stations (upstream and</td>
<td>Yando River</td>
<td>Contractor/RREA/EPA</td>
</tr>
<tr>
<td></td>
<td>Parameters to be monitored: pH, conductivity, turbidity, suspended sediments, oxygen, coliform bacteria, mineral oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Air Quality**

<table>
<thead>
<tr>
<th>Generation of dust</th>
<th>The main impact to air quality during construction will be increased dust levels from construction machinery, cement mixing and road construction. Using speed breakers for dust suppression will mitigate dust generation from construction traffic. Exposed parts of the service roads should be compacted with laterite, particularly through villages. The main access road to the dam and powerhouse will be compacted. Regular monitoring of air quality at three locations in the construction area. Parameters to be monitored: Dust, CO, NO2, SO2, oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All construction sites, all access roads</td>
</tr>
<tr>
<td></td>
<td>Contractor/RREA/EPA</td>
</tr>
</tbody>
</table>

**Noise**

<table>
<thead>
<tr>
<th>Noise Impacts</th>
<th>During construction, noise will be generated from vehicular movements, sand and aggregate processing, concrete mixing, construction noise. The main potential impact of high noise levels will be on construction workers.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Construction site</td>
</tr>
<tr>
<td></td>
<td>Contractor/RREA/EPA</td>
</tr>
</tbody>
</table>
Mitigation measures for noise impacts on construction workers will include standard occupational health and safety practices such as ear protection and enforcement of exposure duration restrictions. Parameter to be monitored: Regular monitoring of noise levels at three locations in the construction area.

### Solid Waste and Hazardous Materials

| Hazardous and non-hazardous waste | I. Disposal of domestic waste and construction waste will occur regularly to approved disposal sites.  
II. Hazardous waste will be collected and stored on-site in approved facilities according to relevant EPA standards.  
Hazardous waste will then be removed from site to EPA approved hazardous waste disposal facilities.  
Parameters to be monitored: Ensure that standards are followed | Construction Sites | Contractor/RREA/EPA |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous materials</td>
<td>Potential impacts to the environment are from accidental spillages affecting soil, groundwater, and adjacent</td>
<td>Construction Sites</td>
<td>Contractor/RREA/EPA</td>
</tr>
</tbody>
</table>
water bodies. Mitigation measures to prevent spillage will include installing appropriate hazardous materials storage facilities.
Parameters to be monitored: Ensure that standards are followed

<table>
<thead>
<tr>
<th>Flora</th>
<th>Impact on flora</th>
<th>Entire project site</th>
<th>Contractor/RREA/EPA/FDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Vegetation will be removed at the construction sites. All work will be carried out in a manner such that damage or disruption to vegetation is minimized. After completion of construction activities, temporarily occupied areas will be re-vegetated. All vegetation at the project site is widely distributed and there will not be any reduction of threatened habitats caused by construction activities.</td>
<td>Entire project site</td>
<td>Contractor/RREA/EPA/FDA</td>
<td></td>
</tr>
<tr>
<td>(ii) The temporary increase in workers to the construction site will increase the potential for illegal fuelwood and non timber forest product collection</td>
<td>Entire project site</td>
<td>Contractor/RREA/EPA/FDA</td>
<td></td>
</tr>
</tbody>
</table>
and hunting. Mitigation measures will include (a) limit fuelwood collection to old farm sites, (b) provision of environmental training on environmental management issues, (c) environmental protection, capacity building of staff, and imposing penalties for illegal activities, and (d) community awareness campaign.

(iii) Building (access roads) and improvement (highway) of roads, and transmission lines in relation to the project will increase access to the forested areas in the vicinity and potentially increase illegal timber harvesting. Ongoing monitoring, law enforcement, and sanctions will be necessary to control illegal timber harvesting activity. The construction and maintenance of transmission line rights-of-way, especially those aligned through
forested areas, may result in alteration and disruption to terrestrial habitat, including impacts to avian species and an increased risk of forest fires.

Site transmission and distribution rights-of-way, access roads, lines, towers, and substations to avoid critical habitat through use of existing utility and transport corridors for transmission and distribution, and existing roads and tracks for access roads, whenever possible;

<table>
<thead>
<tr>
<th>Fauna Impact on fauna</th>
<th>Entire project site</th>
<th>Contractor/RREA/EPA/FDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) There is an increased potential for illegal wildlife hunting in association with the temporary increase in workers. Mitigation measures will include (a) provision of environmental training on environmental management issues, and (b)environmental protection and imposing penalties for illegal activities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) Construction activities will disturb the habitat of terrestrial animals immediately adjacent to the project site. This may</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

81
result in movement of wildlife from the project vicinity to other forested areas.

There is a potential for avian collision and electrocution. To address this impact:

Align transmission corridors to avoid any critical habitats that are encountered during the installation of transmission lines;
· Maintain 1.5 meter (60-inch) spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;
· Retrofit existing transmission or distribution systems by installing elevated perches, insulating jumper loops, placing obstructive perch deterrents (e.g. insulated ”V’s”), changing the location of conductors, and / or using raptor hoods;

Parameters to be monitored: Illegal activities (timber harvesting, hunting, mining) and specific areas will be monitored.
| Impact on aquatic life | During initial filling of the forebay tank, compensation flow will be maintained downstream of the dam. The forebay tank will be filled up as fast as possible. Enforcement of regulations against illegal fishing activities such as using explosives will be imposed through sanctions such as fines. Parameters to be monitored: Illegal activities | Yando river | Contractor/RREA/EPA |
| Operation Phase |  |  |  |
| Soil | (i) Soil contamination will be prevented by installing secondary containment at wash down and refueling areas, and at fuel storage sites. All hazardous wastes and hazardous materials will be stored in properly designed storage facilities. In case of spills, the Power Plant Operator will undertake monitoring. (ii) Scour at the water outlet will be minimized through appropriate engineering design such as placement of erosion protection (iii) Rehabilitation ( revegetation) areas will be monitored to contain potential erosion. | Powerhouse, workshops, storage areas, and water outlet | RREA/EPA/YHPM |
| Wastewater disposal | There will be no direct discharge of untreated sanitary | Hydropower plant and accommodation | RREA/EPA/YHPM |
| Water quality | (i) Monitoring will be carried out of water quality parameters at 2 locations upstream and downstream of the river. Parameters to be monitored at all locations: Temperature, oxygen, pH, turbidity.  
(ii) Rapid water level fluctuations from peaking should be made more gentle by stepwise start and stop in the power station.  
(iii) Roads will be maintained in accordingly in order to minimize negative impacts on the river. | Yando River | RREA/YHPM/EPA |
| Noise impacts | Noise will be generated from the generators. Noise reduction measures will be taken where required to reduce the noise level at the project boundary. Mitigation measures during operation for noise impacts on workers will include standard occupational health and safety practices. | Hydropower plant | RREA/YHPM/EPA |
| Solid waste disposal | Domestic and industrial wastes from the hydropower plant and accommodation facilities will be disposed of in well designed waste disposal sites. | Hydropower plant and accommodation area | RREA/YHPM/EPA |
Replacing existing transformers and other electrical equipment containing PCB, and ensuring appropriate storage, decontamination, and disposal of contaminated units;

Prior to final disposal, retired transformers and equipment containing PCB should be stored on a concrete pad with curbs sufficient to contain the liquid contents of these containers should they be spilled or leaked. The storage area should also have a roof to prevent precipitation from collecting in the storage area. Disposal should involve facilities capable of safely transporting and disposing of hazardous waste containing PCB;

Surrounding soil exposed to PCB leakage from equipment should be assessed, and appropriate removal and / or remediation measures should be implemented

<table>
<thead>
<tr>
<th>Aquatic life</th>
<th>(i) The regulation will have impact on the aquatic life downstream. In the dam, fish will be prevented from entering the forebay tank. Fish will be allowed to move through a channel constructed in the dam for water flow downstream,</th>
</tr>
</thead>
<tbody>
<tr>
<td>River downstream</td>
<td>RREA/YHPM/EPA</td>
</tr>
</tbody>
</table>
which will limit their movement. However, most of these species will survive in small populations in the upstream part of the river and in the tributaries.

(iii) Downstream of the power station, outlet release of compensation flow (from the dam) will reduce negative impacts when the power plant is not operating. During peak production in the power station, daily start and stop will be taken stepwise to minimize impacts on aquatic life.

Parameters to be monitored: Monitoring will be done on fish yield and fish species composition in the downstream of the river.

<p>| Reduced water flow at affected river section | A release of compensation flow is recommended. As the current level of baseline data on the riverine environment makes it difficult to recommend the magnitude of such a flow, it is recommended that the knowledge base on aspects related to hydrology, aquatic and riparian ecology, technical design and economics be improved. This may be done through a study that covers, among other issues, both the wet and | River section between dam and power station outlet, and downstream power station | Project proponent |</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Project Area</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flora and fauna rehabilitated areas</td>
<td>Enforcement of rules of the reserve and forest exploitation must be done. Monitoring (by guards) for illegal activities in forest around project areas and the imposing of sanctions as fines will be continued.</td>
<td>Project area</td>
<td>RREA/YHPM/FDA</td>
</tr>
<tr>
<td>Fires</td>
<td>Monitoring right-of-way vegetation according to fire risk; Removing blowdown and other high-hazard fuel accumulations; Time thinning, slashing, and other maintenance activities to avoid forest fire seasons; Disposal of maintenance slash by controlled burning. Controlled burning should be carried out in the mist of fire suppression equipment (fire extinguisher), and typically must be monitored by a fire watcher; Establishing a network of fuel breaks of less flammable materials or cleared land to slow progress of fires and allow fire fighting access</td>
<td>Project Area</td>
<td>YHPM</td>
</tr>
<tr>
<td>Electrical fires-households, project facility</td>
<td>Electrical fire outbreaks could occur due to improper connection or use of inappropriate</td>
<td>Communities, power house, substations</td>
<td>YHPM/RREA</td>
</tr>
</tbody>
</table>
equipment. Appropriate fire extinguishers should be maintained at centralized locations in each of the villages being supplied with electricity.

Additionally, the power house and substation must also be fitted with fire extinguishers.

**Occupational Health & Safety at all phases of the Project**

<table>
<thead>
<tr>
<th>Live Power Lines</th>
<th>Only trained and certified personnel should be allowed to maintain or repair electrical equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All live power distribution lines should be deactivated and properly grounded before work is performed on, or in close proximity, to the lines;</td>
</tr>
<tr>
<td></td>
<td>Live-wire work should only be conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following:</td>
</tr>
<tr>
<td></td>
<td>• Distinguish live parts from other parts of the electrical system</td>
</tr>
<tr>
<td></td>
<td>• Determine the voltage of live parts</td>
</tr>
<tr>
<td></td>
<td>• Understand the minimum approach</td>
</tr>
</tbody>
</table>

Project area: RREA/YHPM/EPA
distances outlined

• for specific live line voltages
• Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system

Workers should not approach an exposed energized or conductive part even if properly trained unless:

• The worker is properly insulated from the energized part with gloves or other approved insulation; or,
• The energized part is properly insulated from the worker and any other conductive object; or,
• The worker is properly isolated and insulated from any other conductive object (live-line work).

Where maintenance and operation is required within minimum setback distances, specific training, safety measures, personal safety devices, and other precautions should be defined in a health and safety plan.
<table>
<thead>
<tr>
<th>Working at height on poles and structures</th>
<th>Project area</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Structures should be tested for integrity prior to undertaking work;</td>
<td>RREA/YHPM/EPA</td>
</tr>
<tr>
<td>· A fall protection program should be implemented that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others;</td>
<td></td>
</tr>
<tr>
<td>· Establishment of criteria for use of 100 percent fall protection (typically when working over 2 meters above the working surface, but sometimes extended to 7 meters, depending on the activity). The fall protection system should be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point;</td>
<td></td>
</tr>
<tr>
<td>· Safety belts should be of not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident;</td>
<td></td>
</tr>
<tr>
<td>· When operating power tools at height, workers should use a second (backup) safety strap;</td>
<td></td>
</tr>
<tr>
<td>· Signs and other obstructions should be removed from poles or</td>
<td></td>
</tr>
</tbody>
</table>
structures prior to undertaking work;
· An approved tool bag should be used for raising or lowering tools or materials to workers on structures.

| Electric and magnetic fields | Potential exposure levels in the workplace should be identified, including the use of personal monitors during working activities; |
| Project area | RREA/YHPM/EPA |
| Training of workers in the identification of occupational EMF levels and hazards; |
| Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers; |
| Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the Institute of Electrical and Electronics Engineers (IEEE). Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational |
exposure reference levels (e.g. 50 percent). Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

<table>
<thead>
<tr>
<th>Community Health and Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrocution</strong></td>
</tr>
<tr>
<td><strong>Noise</strong></td>
</tr>
<tr>
<td><strong>Visual Intrusion</strong></td>
</tr>
</tbody>
</table>
· Siting power lines, and designing substations, with due consideration to landscape views and important environmental and community features;
· Location of high-voltage transmission and distribution lines in less populated areas, where possible;
· Burying transmission or distribution lines when power must be transported through dense residential or commercial areas.

8.4 Budget (draft) for recommended environmental/social mitigation and monitoring

The budget for the recommended mitigation measures and monitoring in rounded figures. Detailed cost estimates are given in Annex 5 (Environmental/Social Protection and Capacity Building Plan). Costs for ordinary mitigation measures directly linked to the construction activity, such as erosion control measures at construction sites and access roads, are not included in the budget. These costs should be included in the construction costs.

<table>
<thead>
<tr>
<th>Item</th>
<th>Costs USD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Pre-Construction and Construction Periods</strong></td>
<td></td>
</tr>
<tr>
<td>Environmental Protection Measures</td>
<td></td>
</tr>
<tr>
<td>a. Environmental Protection and Capacity Building</td>
<td></td>
</tr>
<tr>
<td>i. Capacity Building for Institutions (RREA.YHPM)</td>
<td>15,500</td>
</tr>
<tr>
<td>ii. Workers</td>
<td>2,500</td>
</tr>
<tr>
<td>iii. Environmental Awareness</td>
<td>3,000</td>
</tr>
<tr>
<td>Monitoring</td>
<td></td>
</tr>
<tr>
<td>a. Monitoring during Project Pre-Construction and Construction</td>
<td></td>
</tr>
<tr>
<td>i. Water Quality</td>
<td>4,840</td>
</tr>
<tr>
<td>ii. Air and Noise</td>
<td>2,000</td>
</tr>
<tr>
<td>Operating Cost of ESMU (per annum)</td>
<td>10,000</td>
</tr>
<tr>
<td><strong>Total (A)</strong></td>
<td>37,840</td>
</tr>
</tbody>
</table>
B. Operation Period (Annual Cost)
a. Water Quality / Fish Yield and Species 7,400

C. Social Economic Monitoring (Annual Cost) 2,000
a. Resettlement and Compensation
b. Community concerns
c. No. of persons benefiting from power supply
d. Relationship between YHPM and community

Total (ABC) 42,240

8.5 Project Abandonment

There is no particular time frame set for the closure and decommissioning of the project. Considering the current peace and security existing in the country couple with the capacity and commitment on the part of the World Bank to the project and the local inhabitants’ willingness to manage the project, complete abandonment seems unlikely.

However, given that there is always a risk of pre-mature abandonment for technical, organizational, political or financial reasons, it is necessary to envisage a Closure Plan.

In case of abandonment, the Project Proponent will be responsible to ensure that the cessation of the Project would be carried out in a responsible manner and a rehabilitation plan would be prepared to ensure the restoration of the environment and safe disposal of any waste remaining.

The purpose of the rehabilitation program is to restore the Project site to render it stable enough so as not to become a source of environmental repercussions in the future as well as minimizing aesthetic and visual impacts. It is also meant to prepare the area for other development or maintained as natural forest. However, the ability of reverting back to the forest condition will depend on the stage when work on the project is stopped. Artificial regeneration by planting with appropriate species will create a forest environment over a long period.

Some of the rehabilitation program proposed for this Project includes:

- Revegetation of cleared areas with fast growing indigenous shrubs and grass.
- Install blockage into all the project roads to discourage hunting or unauthorized personnel from entering into the Project area.
- Remove the base camps, workshops, power house etc. All waste remaining must be disposed off safely.
- Re-establish native vegetation to enable the formation of a new ecological equilibrium of the area.
- All remaining structure, machinery and equipment should be removed. Waste generated from the demolition of structure should be properly disposed off or buried.
CHAPTER 9.0: PUBLIC PARTICIPATION

Adequate information was given to the public regarding the nature of the project, location, duration, and the donors and implementing partners involved in the construction and operation of the proposed project. The information was published in local dailies and. Meetings were held with stakeholders regarding the project and their views, comments and concerns were recorded to form part of the public participation.

Three (3) communities within and surrounding the project area were also informed and public meetings were held to explain fully the nature of the project. Concerns raised by the communities were also documented. Local authorities were also contacted regarding the project. Issues raised by the communities and stakeholders, including attendance and photos are found in Annex 1 and 2.

9.1 Government Institutions (Central)

Environmental Protection Agency of Liberia

Ministry of Lands, Mines & Energy: Hon. Rufus Tarnue
Acting Assistant Minister-Energy

Rural & Renewable Energy Agency: Mr. Augustine Guannue (06)
Director

9.2 Government Authority (Local)

Hon. Galakpai Kortimai- Superintendent, Lofa County (06)

9.3 Selected and Affected project Communities in which public hearing were conducted

1. Yandohun
2. Dangalahun 1
3. Dangalahun 2
CHAPTER 10.0 CONCLUSION AND RECOMMENDATIONS

The unanimous support being demonstrated by the people of Yandohun, Dangalahun 1 and Dangalahun 2 for the rehabilitation of the micro-hydro project indicates the level of acceptance the project has so far received from the local communities. The success of this project is highly dependent on sustaining this current level of support and enthusiasm amongst the communities and being able to achieve community expectations. This calls for sustained public awareness and involvement of the communities at every stage of the project.

From an impact perspective, the project has both short and long term social economic benefits for the people of Yandohun and surrounding communities, which could boost the development of micro-enterprise development and help to alleviate poverty in a society where the average person lives on less than US1.00. The negative social impacts associated with the project are quite limited and manageable, considering that this development is not new to the area and that mitigation and monitoring measures would be followed throughout the project.

Just like the initial construction of the micro-hydro power station, the rehabilitation of the existing facility at Yandohun and its operation could have immediate and long-term effects on the environment. These impacts relate to runoff, erosion, water quality, terrestrial ecology (fauna and flora), air quality and noise. Considering the size of the facility and the approximately 3 acres of land that will be occupied, the impact is expected to be limited in magnitude and site specific. However, the nature and extent of the impacts will depend on the practices. Careful planning and management of potential impacts identified in this study is essential to reducing these negative effects.

Any impacts to the environment will be within acceptable limits once the RREA and the Yandohun Hydro Power Management follows their commitment to best environmental practices and in particular carefully adhere to the guidelines laid down by EPA and the World Bank.

Under the no-action alternative, the adverse impacts associated with the project would not occur, and neither would the project benefits. On the basis of the above, it is recommended that the project be constructed for the benefit of the host communities.

The long term sustainability of this project depends on the responsibility of the management of RREA to conform to laws, regulations and guidelines as it relates to its operations as well as establishing genuine partnerships with other stakeholders, in particular the communities involved, World Bank, Ministry of Lands, Mines & Energy and EPA.

The proposed project’s anticipated environmental benefits include (i) supply of power resources in urban communities, (ii) less emission of greenhouse gases, (iv) a general contribution to the development of the area (v) enhance watershed maintenance and protection. The issue of enhanced environmental protection and awareness plan is some of the salient items included in the project planning to adequately address the impacts to an acceptable level.
This EIS has been prepared following an identification of the project activities and assessing their potential impacts based on best-practice guidelines. Accordingly, mitigation and management actions required to be undertaken to minimize adverse environmental and social impacts of the project have been identified. It is expected that these recommendations will be adopted during project construction and operations and monitored by the requisite regulatory institutions, principally the EPA and Ministry of Lands, Mines & Energy.
4. Hawthorne 1995a  
10. www.mammals-worldwide.info/liberia.htm  
Annex 1: Minutes & Attendance from Public Consultations

Minutes from Stakeholders Consultation

Name of Stakeholder : Hon. –Lofa County Superintendent
Date : February 25, 2010
Venue : Voinjama
Time : 1800 hr

Minutes

The meeting commenced with an introductory statement and a presentation of the overview of the World Bank sponsored project in partnership with the Liberian Government through the Rural and Renewable Energy Agency (RREA) project to the Honorable Superintendent, Galakpai W. Kortimai by Mr. Solomon P, Wright, a World Bank consultant on the Yandohun micro hydro project. Mr. Wright highlighted the intentions of the Bank to the project and its developmental benefits within the project area. The Honorable Superintendent thanked the team for the information and acknowledges his understanding and direct involvement to the proposed Yandohun micro hydro project and that he whole heartedly welcome such a project. He informed the Consultant and his team that he was very pleased that such initiative is about to commenced after wishing so long that his people will once benefit from such a development. The superintendent also acknowledged that this initiative will lead to the development of better infrastructures and economic development. At the end of his remarks, the Honorable Superintendent stresses the readiness of his people to support the project and raised the following issue/concern:

Issue/concern:

- The Superintendent acknowledged that his only hope is that the project commence in time as bad road during the heavy rains might hindered the time line of the project.
Minutes from Public Hearing

Date: February 27, 2010
Venue: Yandohun Town, Lofa County
Time: 09:30.

Agenda:
1. Opening prayer/welcome remark
2. Introduction/purpose of meeting
3. Highlight of the rehabilitation plan for Yandohun micro hydro project
4. Community concerns, comment and recommendation
5. Community socio-economic data collection

The above agenda was developed and accepted for used in the entire public hearing which took place in the three communities affected by the project in Lofa County.

Minutes

The hearing opened with a prayer by Abu Baka, Imam of Yandohun Mosque. The speaker of the town, Muyan Kamara welcomes the team and introduced the officials of the town, which subsequently lead to an introductory statement presented by the Bank Consultant, Mr. Solomon Wright. He introduced his team members and then went on to provide detail information on the proposed rehabilitation plan for the Yandohun micro hydro project. The Bank Consultant informed the people that they play a very important role in the development and sustainability of the proposed project. He also gives a detail explanation and meaning of the Environmental Protection and Management Law of Liberia (EPML), guidelines of the Environmental Protection Agency (EPA), Environmental and Social Impact Assessment (ESIA) and Environmental Management Plan (EMP) and explained to the hearing that the process of enlisting their concerns, comments and opinions regarding the proposed project is part of the EIA process mandated by the EPA in keeping with the Environmental Protection and Management Law of Liberia. He indicated that because of the Yandohun location to the project, its public hearing was necessary to incorporate the inputs of the youth, women, elders and disable, etc within the various environmental studies mandated by the EPA.

The community thanked the consultant and his team for the manner in which the information was given and indicated that the information has cleared some doubt and misunderstanding they had about the entire undertaking.

The below issues/concerns were raised by the collective agreement from the participants to form the basis of their issue of concerns to be included in the environmental study.
Issues/concern raised by the public hearing in Yandohun

- Will there be incentive for skilled laborers given by the town to work along with contractor during project development?
- In the case of resettlement, who will be responsible for the building of the relocated home and what will the resettlement package cover?
- Will there be compensation for damage property as a result of the project development?
- Fear of individual wiring their own house as prerequisite to getting connected from the light poles.
- Will the town people be solely responsible for the building of the project infrastructures (warehouse, contractors’ quarter)?
- Will the relocation also provide land for farming in the new location?
- Will compensated for crop on none legitimate land be considered?
- Who will benefit from job?

These questions were answer by the consultant in regards to the understanding of the rehabilitation of the Yandohun micro hydro project.

The following recommendations were made by participants at the hearing;

1. That the committee to be set up as responsible body for the management of the micro managed hydro project be also responsible to oversee the wiring of residential building to avoid short circuit and other technical disaster;
2. 

At the close of the public hearing, the community people expressed their willingness and support for the project. The town acknowledges that the project is theirs and that they are willing and able to work, whether voluntarily or by compensation for the development of the project. They also expressed willingness to relocated in case their homes fall in the paths of the Yandohun grid line. They recounted how for nine years the town worked voluntarily to built the first hydro plant, now lying in ruin and that the town has always have the belief that one day their town will be lighted again. The spokesman for the town acknowledged that the town realizes the project will provide jobs and other economic and social benefits that will improve their lives.

The Bank consultant then collected some basic socio-economic data from the town in completion of the socio-economic survey.
YANDOHUN MICRO-HYDRO PROJECT
PUBLIC CONSULTATION
YANDOHUN TOWN HALL, MARCH 27, 2010

Time: 9:30

Attendance

1) Halagi Dauda Kamara - Elder
2) Abu Konneh - Elder
3) Fatumah Kamara - Elder
4) Abraham B. Ambrile
5) 
6) Moduah Amara - Town Chief
7) Foday Kakpa
8) Fehah Kakpa
9) Aliyah Kasim
10) Francis Momoh - Town Secretary
11) Alice Kamara
12) Garneh Vakome
13) James Kamara - Town Elder
14) Foday Kamara Kaba - Elder - Yundahun
15) Boaka M. Karya
16) Amara Kolucion - Elder
17) Janneh Muia
18) Prince Vinnie CUH
19) Joseph Sanu Maingor - Medical Assistant
20) Lamin Kamara - Elder
21) Aida Momoh - Elder
22) Mobujo Koya
22) Siraha
23) Boorma Nangle Youth
24) Neema Juma - Youn
25) Sinanda Idris - Elder
26) Sama Swaray - Town Chair lady
27) Boakai K. Muso
28) George K. Boima Teacher
29) Fomba Lahai Elder
30) Grima Momoh - Blacksmith
31) Mama Tonode
32) Jenepa Kamara
33) Baniyu Tonode
34) Ayarai Fatooma - Youth Leader
35) Aminata Fatooma - Youth Leader
36) Momoh Borrail Elder
37) Fatumah - Elder
38) Mosifoh Kamara - Youth
39) Hizina Amara
40) Fementa Mumba
41) Vreny
42) Julius Kamara
43) Fatma Kamara
44) Anna Sheriff
45) Sandra Brima
46) Fatijuun Kamata C.H.I.W. Yallah
47) Fattama Kamata - Club Youth Leader
49 - MONICH SAO - CHURCH FATHER
50 - FOMENT KAMIRA - REVEREND
51 - HANIA MUSA - ELDER
52 - BAWANE KAMIRA - ELDER
53 - HANIA SAMOKAI - MIDWIFE
54 - ANI A KAMIRA
55 - SATIRA TONDEE
56 - MUSE S.KAMIRA
57 - MESSIE KAMIRA
58 - MUNDA KAMIRA
59 - BONKA POPA
60 - MUSA KAMIRA
61 - ABRAHAM KAMIRA
62 - YADIA KAMIRA - ELDER
63 - FATI KAMIRA
64 - FIATA KAMIRA
65 - NDIKZI MUSA
66 - BONKA JOM
67 - MONICH J. KAMIRA - MAIDANZIYI
68 - AMABA MASVUNYI - CHIEF MASVUNYI
69 - FOAY MUSA - MASVUNYI
70 - AMBULLEN KAMIRA II
71 - AMABA SHAFFA - CARPENTER
72 - AMABA AMABA - MIDWIFE
73 - FATI KAMIRA - ELDER
74 - FIATA SAMOKAI - ELDER
75 - JACKSON BONKA
76 - LUZI KAMIRA
77 - JENNIFER AMABA
28 - Fatmata Mollay - Elder
29 - Manita Koroma - Youth
30 - Fatma Koroma organiser
31 - Koroma Koroma - Treasurer
32 - Lusia Koroma
33 - Kadi Koroma
34 - Mamadi Koroma
35 - Marie Koroma
36 - Bintu Koroma
37 - Jane Koroma - Elder
38 - Momoh Koroma - Chief - Chairman (president)
39 - Jane Koroma - Youth
40 - Jemmeh Koroma - Elder
41 - Mary James
42 - Hana Koroma
43 - Kadi Koroma - Youth
44 - Braima Yaya Elder
45 - Mustapha Koroma - Imam
46 - Momoh Koroma
47 - Bintu Fusu - Youth
48 - Missie Bintu
49 - Sule Fusu
100 - Fatim Bintu
101 - Mollay Bintu
102 - Mollay Koroma
103 - Fatima Koroma
104 - Janina Momo
105 - Mollay Momo
106 - Fatima Koroma
107 - Lahai Swamy
108 - Miatta Koroma
109 - Varrney Juma - Harbour
110 - Smith Koroma
111 - Nabi Koroma
112 - Moses Koroma - Principal
113 - Bintu Sheriff - Elder
114 - Koroma Varolia - Chief Carpenters
115 - Mohamed Saini
116 - Jammama Varley
117 - Kandu Koroma
118 - Bintu Varley
119 - Mohamed Saini
120 - Amba Koroma
121 - Suleman Mohamed - Youth
122 - Janneh Shoda - FF Youth
123 - Yusu Amusa - Youth
124 - Amba, Koroma
125 - Jemmeh Momo
126 - Lusia Musa
127 - Momo Momo
128 - Lusia Koroma
129 - Amby Amfara
130 - Foday Kanu
131 - Fallah Amfara
132 - Hame Musa
133 - Ballay Musa
Minutes from Public Hearing

Date: February 27, 2010
Venue: Dangalahun 2, Lofa County
Time: 1400 hr.

Agenda:
1. Opening prayer/welcome remark
2. Introduction/purpose of meeting
3. Highlight of the rehabilitation plan for Yandohun micro hydro project
4. Community concerns, comment and recommendation
5. Community socio-economic data collection

Minutes

The town chief of Danglahun 2 welcomes the community hearing in his Town. The meeting was called to order by prayer from the town’s religious leader, Al Fatiyan. The public hearing was informed about the intent of the team visit and the work which was being done on behalf of the Liberian Government through the RREA in partnership with the World Bank. The citizens of the village was told that the hearing was in compliance to the Environmental Protection and Management Law of Liberia (EPML) and that the team was in the process of enlisting public concerns, comments and opinions regarding the proposed project as part of the environmental study. The hearing was informed about the entire work which is to be done and what their role as citizens will be for the development of the project. Citizens of the village was cautioned to speak out in order to help the project as doubt and misunderstanding about the proposed Yandohun micro managed hydro power project on the part of the citizens will not be healthy for the development of the work. They were than told that their study is meant to solicit views, concerns and comments from the community regarding what they as citizens think about the project and what they will wish to recommend.

On behalf of the entire town, the town chief, thanked the team and informed them that the town was aware of the project and that the entire town and citizens whole heartedly welcome the project and are will to contribute labor to support the undertaking. The town however raise this concern: Will people be compensated for their labor?

The question was recorded to form part of the direct concern from the hearing, however, the locals were reminded that their time and sacrificial support given to the project are their way of owning the project and contributing to the development of the hydro which will eventually benefit them and their children.

No recommendation was made by the citizens of Dangalahun 2.

Socio-economic data was recorded in reference to the town.
YANDOHUN MICRO-HYDRO PROJECT
DANGLANHUN PUBLIC CONSULTATION
DANGLANHUN TOWN, MARCH 27, 2010

TIME: 12:30

ATTENDANCE

1. Famatta Saybo
2. Bensu Kamara
3. Faramatta Sheriff
4. Moumoune Bah Kamara
5. Fomba Kamara
6. Boaka Kamara
7. Mou'ama Kamoh
8. Blama Moumoh
9. Mamusu Kamara
10. Miarba Moumoh
11. Mou'ama Boaka
12. Musa Kamara
13. Momoh S Kamara
14. Hania Moumoh
15. Jenbah Sandu
Minutes from Public Hearing

Date : February 27, 2010
Venue : Danglahun 1, Lofa County
Time : 1500 hr.

Agenda:
1. Opening prayer/welcome remark
2. Introduction/purpose of meeting
3. Highlight of the rehabilitation plan for Yandohun micro hydro project
4. Community concerns, comment and recommendation
5. Community socio-economic data collection

Minutes

The people of the village were informed about the visit of the team’s woek, which wasto conduct the Environmental and Socio Impact Assessment for and on behalf of the Government of Liberia through the RREA in partnership with the World Bank. The citizens were told that the World Bank in partnership with the Liberia Government was in readiness to support the rehabilitation of the previously 30kW Yandohun micro hydro project to a 60kW hydro project to be managed by the citizens themselves in the near future.

The citizens of the town was then told the meeting was in compliance to the Environmental and Management Law of the Republic of Liberia which recognized the full involvement of citizens of a particular project setting and that the hearing process is to enlist public concerns, comments and opinions regarding the proposed project as part of the environmental study mandated by the EPA.

The community expressed joy that they were included in the decision making process of the proposed development and therefore declared that they welcome the project with opened heart.

The below issues/concerns were raised by the collective agreement from the participants to form the basis of their issue of concerns.

The town announced that it has no pressing concerns regarding any negative aspects of the proposed project; it however wish to give out the following concerns:

1. Concern as to whether there will be compensation for volunteer workers during the project development phase;
2. Will residents of the village who are skilled in particular technical field (carpentry, masonry, etc.) be given priority to be gainfully employed during the project’s developmental and completion phases?.
TIME: 2:10

ATTENDANCE

1) Banidu Kava
2) Jebah Kamara
3) Banidu Kamara
4) Amie Boakai
5) Hawa momoh
6) Forba momoh
7) Boakai Ngombu
8) Samukai Kamara - town chief
9) Moninia Kamara
10) Baubah Kamara
11) Amadou Kamara
12) Blama Kamara
13) Banidu Saifu
14) Joseph Kamara
15) Ghassay Kamara
16) Huhub Kamara
17) Mamie Samukai
18) Fomba Kamara
Annex 2: Letter of Notification
REPUBLIC OF LIBERIA
MINISTRY OF LANDS, MINES AND ENERGY
P.O. BOX 10-9024
1000 MONROVIA 10, LIBERIA, WEST AFRICA
TEL: (231) 027214009, FAX: (231) 7780999

Office of the Minister

RL/MLME/EHS/RREA224/10

Tuesday, June 08, 2010

Dr. Denis M. Sandy
Minister
Ministry of Lands, Country Planning and the Environment
3rd Floor; Youyi Building
Freetown, Sierra Leone

Dear Hon. Minister:

I present my compliments and wish to officially notify you that the Government of Liberia in partnership with the World Bank is embarking on the rehabilitation of the pre-war community managed micro-hydro power plant located in Yandohun, Kolahun District, Lofa County, Liberia.

The rehabilitation of the proposed Yandohun micro-hydro power plant is an approach by the Liberian Government to increase rural energy access and improve the livelihoods of rural inhabitants through the provision of basic social services (electricity for schools, clinics, households, etc.). The project is an initiative by the Liberian Government which is expected to be implemented by the Rural and Renewable Energy Agency (RREA).

The town of Yandohun and the villages of Dangalahun 1 and Dangalahun 2, which are expected to benefit from the project are drained by the Yando River. Northwest, West and Southeast of the flow direction is the village of Dangalahun 2, the town of Yandohun and the village of Dangalahun 1 respectively. The Yando River is a tributary to the Maigovi River. The Maigovi River joins the Moa River, which forms a tributary to the Mankona River.

Owing to the fact that the Yando River is located in the Mankona River Basin, which is shared between Liberia and Sierra Leone, and in compliance with the World Bank Projects International Waterways Policy OP7.50, the Government of Liberia is requesting from the Government of Sierra Leone, a notice of no objection to the usage of the river; thus, paving the way for commencement
Republic of Liberia
Ministry of Lands, Mines and Energy

P.O. Box 10-9024
1000 Monrovia 10, Liberia, West Africa
Tel: (231) 027214009, Fax: (231) 7780999

Office of the Minister

of the project. An Environmental and Social Impact Assessment has been conducted in the Yandohun/Dangalahun communities, and no adverse environmental or social impacts have been found, since this project is both run-of-river and rehabilitation, requiring no new construction.

Thank you for your kind cooperation in this matter.

Kind regards,

Very truly yours,

Eugene Shannon (PhD)
Minister

Cc: EPA, Liberia

Kristin K. Stroup, Africa Energy Department, World Bank Liberia Country Office

Prof. Ogunlade R. Davidson, Minister of Energy and Water Resources,
Republic of Sierra Leone
Annex 3: Photos from Public Consultations

Yandohun (Elder stressing a point)

Yandohun (Citizens shows support for project)

Yandohun (Local project management listens)

Yandohun (elders/women leaders show support)

Dangalahun 2 (cross section of citizens)

Dangalahun 1 (cross section of citizens)
## Annex 4: Public Input Received on NOI

<table>
<thead>
<tr>
<th>DATE</th>
<th>NAME OF PERSON</th>
<th>LOCATION</th>
<th>CELL NUMBER</th>
<th>INPUT (CONCERN/FEAR, COMMENT, RECOMMENDATION)</th>
</tr>
</thead>
</table>
| 17/03/10   | Pele Paelay                         | Monrovia, Liberia       | 076-182-839 | - Concerns as to whether an Environmental and Socio Impact Assessment was ever carried out for the previous 30 kW hydro power in Yandohun.  
- On the issue of stakeholders review of the final document, concern as to how the EPA goes about selecting stakeholder for any review.  
- Is the present proposed Yandohun micro hydro project apart from the previous one the only in the country? |
| 19/03/10   | Charles T. O. King, III President, Liberia Finance & Trust Corporation | Monrovia, Liberia | 06-535-633 | Raise concern about how the project can be potentially labeled as being Clean Development Mechanism (CDM) through the development of a Public/Private Initiative (PPI) to have clean energy by the project undergoing the following:  
- Maintenance  
- Monitoring  
- Sustainability  
- Depreciation |
ANNEX 5: Environmental/Social Protection and Capacity Building Plan

i. Capacity Building of Institutions (RREA/YHPM)
   • ___ Persons RREA/ESMU (3), YPHM (3)
   • Cost per class – 2,500
   • 3 classes during the first 3 years – 7,500
   • Insitu Equipment for ESMU-8,000.00

Total cost = 15,500

Training for project workers and villagers starting 2 months before Construction (training includes a refresher course in the beginning of year 2 of the Construction Period) = 2,500.00

Total cost = 2,500

ii. Environmental Awareness Plan
Leaflets, Posters, broadcasting, Regular Postings and media updates, community sensitization meetings etc.
Total cost = 3,000.00

iii. Costs of the water quality monitoring in the construction phase

The cost of the compliance monitoring is not included in the cost estimate. The budget is based on that the ESMU does the sampling and brings the samples to the laboratory. The budget covers the analysis and the expenses confined with treatment of the data and reporting, and amounts to 4,840.00

Estimated costs of Water Quality Monitoring (USD/year)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field work (done by ESMU, not included in the budget)</td>
<td>0</td>
</tr>
<tr>
<td>Bringing the samples to Monrovia (done by ESMU, not included in the budget)</td>
<td>0</td>
</tr>
<tr>
<td>Analysis (8 parameters, 2 stations, 12 observations per year)</td>
<td>3,840</td>
</tr>
<tr>
<td>Treatment of data and writing the report (20 days of specialist work a 50 per day)</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Total per year 4,840

iv. Estimated costs of Air/Noise Quality Monitoring (USD/year) 2,000

v. ESMU Estimated operation cost 10,000
vi. Monitoring in the Operation Phase

This portion deals with the monitoring of water quality and aquatic life in the operational phase. That is after the reservoir is filled and the power plant has started its operation. Very shortly, the monitoring should cover the following items:
1. Water quality
2. Fish yield and fish species composition

**Water quality monitoring**
Water quality should be monitored with sampling 4 times a year (Jan-Apr-Jul-Oct) at 2 locations, upstream and downstream:

<table>
<thead>
<tr>
<th>Costs of Water Quality Monitoring (Independent Consultant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
</tr>
<tr>
<td>Field work per diem (2 persons x 2 days x 4 obs per year x 50.00)</td>
</tr>
<tr>
<td>Field work travel (175 x 2 x 4 obs)</td>
</tr>
<tr>
<td>Chemical analysis river stations (8 parameters x 2 stations x 4 obs/year)</td>
</tr>
<tr>
<td>Treatment of data and writing the report (10 days of specialist work @ 150 per day)</td>
</tr>
<tr>
<td>Miscellaneous, printing costs, meetings with client, etc</td>
</tr>
</tbody>
</table>

**Total per year**
7,400.00

**vi. Estimated costs of Social/Economic Benefits Monitoring (USD/year)**
2,000

a. Resettlement and Compensation
b. Community concerns
c. No. of persons benefiting from power supply
d. Relationship between YHPM and community

**Grand Total per year**
42,240
Annex 6: Socioeconomic survey data

<table>
<thead>
<tr>
<th>NO</th>
<th>SETTLEMENT 1</th>
<th>COUNTY</th>
<th>GPS COORDINATE</th>
<th>DATE ESTABLISHED</th>
<th>FOUNDER</th>
<th>Estimated population</th>
<th>Estimated no. of houses</th>
<th>Type of Housing</th>
<th>Existing social/public service</th>
<th>Primary source of income</th>
<th>Source of Energy</th>
<th>Monthly H/H energy cost IN Liberian Dollars</th>
<th>Land Tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YANDOHUN</td>
<td>LOFA</td>
<td>0350340/0896157</td>
<td>EARLY 1904</td>
<td>OLDMAN KARLEE</td>
<td>2500-3000</td>
<td>180</td>
<td>Zinc with mud brick Thatch house Zinc with concrete house</td>
<td>CHURCH, MOSQUE TOWNHALL HAND PUMP FOOTBALL FIELD</td>
<td>Farming, Petty trade</td>
<td>Kerosene lamp, oil lamp, flash light, firewood</td>
<td>Tribal</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>DANGLAHUN 1</td>
<td>LOFA</td>
<td>0351387/0897733</td>
<td>2007</td>
<td>MOMO GAYZAH</td>
<td>70-100</td>
<td>11</td>
<td>Thatch house</td>
<td>NONE</td>
<td>Farming</td>
<td>Oil lamp</td>
<td>75-150</td>
<td>Tribal</td>
</tr>
<tr>
<td>3</td>
<td>DANGLAHUN 2</td>
<td>LOFA</td>
<td>0351188/0898912</td>
<td>LATE 1920</td>
<td>MANAH KAMARA</td>
<td>100-150</td>
<td>15</td>
<td>Thatch house</td>
<td>NONE</td>
<td>Farming</td>
<td>Oil lamp</td>
<td>50-100</td>
<td>Tribal</td>
</tr>
</tbody>
</table>

DO YOU HAVE ANY OF THESE DOMESTIC HOUSEHOLD ITEMS?

<table>
<thead>
<tr>
<th>SETTLEMENT 1</th>
<th>RADIO</th>
<th>TELEVISION</th>
<th>WATER HEATER</th>
<th>CELL PHONE</th>
<th>RECHARGABLE LIGHT</th>
<th>FREEZER/ICE BOX</th>
</tr>
</thead>
<tbody>
<tr>
<td>SETTLEMENT 2</td>
<td>RADIO</td>
<td>TELEVISION</td>
<td>WATER HEATER</td>
<td>CELL PHONE</td>
<td>RECHARGABLE LIGHT</td>
<td>FREEZER/ICE BOX</td>
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<tr>
<td>SETTLEMENT 3</td>
<td>RADIO</td>
<td>TELEVISION</td>
<td>WATER HEATER</td>
<td>CELL PHONE</td>
<td>RECHARGABLE LIGHT</td>
<td>FREEZER/ICE BOX</td>
</tr>
</tbody>
</table>

**KEY**

- **PRESENT**
- **NONE**
Annex 7: Economic Information Regarding The Project

The total estimated cost for the project is put at USD$535,00 as outlined below:

**Project Cost (Estimated)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount (USD)</th>
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</thead>
<tbody>
<tr>
<td>1 Pre-Construction Cost</td>
<td>55,000</td>
</tr>
<tr>
<td>2 Mobilization &amp; Construction Machinery</td>
<td>70,000</td>
</tr>
<tr>
<td>3 Project Management &amp; Consultancy</td>
<td>50,000</td>
</tr>
<tr>
<td>4 Construction &amp; Installations</td>
<td>295,000</td>
</tr>
<tr>
<td>5 Transportation &amp; Procurement of Land Vehicle</td>
<td>30,000</td>
</tr>
<tr>
<td>6 Capacity Building &amp; Awareness Programs</td>
<td>10,000</td>
</tr>
<tr>
<td>7 Construction and furnishing of quarters for project construction team</td>
<td>20,000</td>
</tr>
<tr>
<td>8 Contingencies</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>535,000</strong></td>
</tr>
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</table>
Annex 8: Notice of Intent Published in Local Dailies and Posted in Project Communities

**NOTICE OF INTENT**

The general public and all concerned or interested parties are hereby informed that the Government of Liberia in partnership with the World Bank is implementing a new program titled: "Catalyzing New Renewable Energy in Rural Liberia." The implementing agency is the new Rural and Renewable Energy Agency (RREA) established by the Government to implement a significant portion of the National Energy Policy (NEP) in support of the Poverty Reduction Strategy (PRS).

The RREA, with support from the World Bank is in the process of rehabilitating a 30-kW community managed micro-hydro power plant in Yandohun, Lofa County. In keeping with Section 11 of the Environmental Protection and Management Law of the Republic of Liberia (2003) and Annex 1 (Section 6), all new projects that fall under the Environmental Laws of Liberia EIA mandatory listing, including hydro-power installations, are subject to an environmental study.

Based on the above, and also in accordance with the World Bank’s Safeguard Policies and Environmental, Health and Safety Guidelines, Mr. Solomon P. Wright, an EPA Licensed Independent EIA Evaluator has been contracted to conduct an Environmental Assessment in order to prepare environmental and social safeguards documentation capable of addressing the potential environmental and social impacts of the project.

Henceforth, in the process of identifying potential environmental and social impacts that may result from activities of the micro-hydro power plant rehabilitation, the Consultant is receiving inputs from the public, including interested & affected parties beginning February 22 to March 21, 2010. All persons having views, comments or concerns regarding the proposed project are encouraged to

<table>
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<th>OPTION</th>
<th>QUANTITY</th>
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<tbody>
<tr>
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<td>24 PCS</td>
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<tr>
<td>3</td>
<td>10 PCS</td>
</tr>
<tr>
<td>3</td>
<td>30 PCS</td>
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<td>20 PCS</td>
</tr>
<tr>
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<td>10 PCS</td>
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<tr>
<td>TOTAL</td>
<td>3</td>
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<tr>
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<table>
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<td>200 PCS</td>
<td>150 PCS</td>
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<td>150 PCS</td>
<td>100 PCS</td>
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<td>50 PCS</td>
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<td>50 PCS</td>
<td>20 PCS</td>
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<tr>
<td>20 PCS</td>
<td>10 PCS</td>
</tr>
<tr>
<td>10 PCS</td>
<td>5 PCS</td>
</tr>
<tr>
<td>TOTAL</td>
<td>200 CNTNS</td>
</tr>
<tr>
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<td>200 CNTNS</td>
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</tbody>
</table>

<table>
<thead>
<tr>
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<th>QUANTITY</th>
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<td>21000 PCS</td>
<td>700 CNTNS</td>
</tr>
<tr>
<td>7000 PCS</td>
<td>500 CNTNS</td>
</tr>
<tr>
<td>5000 PCS</td>
<td>300 CNTNS</td>
</tr>
<tr>
<td>3000 PCS</td>
<td>200 CNTNS</td>
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<td>100 CNTNS</td>
</tr>
<tr>
<td>1000 PCS</td>
<td>50 CNTNS</td>
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</table>

Through the International Competitive Bidding (ICB), a
Annex 9: Curriculum Vitae of ESIA Evaluators

**CURRICULUM VITAE**

**Personal Details:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solomon P. Wright</td>
<td>Oldest Congo Town</td>
</tr>
<tr>
<td></td>
<td>Monrovia, Liberia</td>
</tr>
</tbody>
</table>

**Nationality:** Liberian

**Contacts:** +231(0)7700-1933

solopwt@yahoo.com

**Academic Qualifications:**

1999-2006  Bachelor of Science (B.Sc.), (Cum-Laude)

College of Agriculture and Forestry (Department of General Forestry)

Completed course work (elective of prospective graduate program) in developing, analysing and processing research methods

1995  Diploma (Upper 4th.)

St. Jean Liberian Catholic High School

Danane, Cote D'Ivoire

1995  WAEC Certificate (Division 1)
Professional Duties:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>INSTITUTION</th>
<th>POSITION/RESPONSIBILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2009 to Present</td>
<td>Green Consultancy Inc. (GreenCons)</td>
<td><strong>Managing Director:</strong></td>
</tr>
<tr>
<td></td>
<td>Earthcons Inc. Monrovia, Liberia</td>
<td>▪ Manage the day to day activities of the company;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Provide administrative environmental related consultancy services as may be expedient;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Engage clients and negotiate contracts and agreements on behalf of the company;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ approve budget etc</td>
</tr>
<tr>
<td>July 2005 to June 2009</td>
<td></td>
<td><strong>Environmental Coordinator:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Supervised and managed the entire environmental section of the company -coordinate and run all field activities including but not limited to the following environmental activities:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Screening of existing environment;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Environmental and socio-economic baseline assessment of projects;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Conducting environmental scoping assessment;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Conduct of Environmental and Socio- Impact Assessment(ESIA) studies;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Liaise with international consultants on the conduct and preparation of environmental report in compliance with standard and guidelines of the Environmental and Management Law of Liberia;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Preparation and analysis of report for the Environmental Protection Agency of Liberia(EPAL)</td>
</tr>
</tbody>
</table>
## CAREER EXPERIENCE

<table>
<thead>
<tr>
<th>YEAR/ Client</th>
<th>INSTITUTION</th>
<th>RESPONSIBILITIES</th>
</tr>
</thead>
</table>
| 2010: World Bank | Consultant | Prepare Environmental Assessment (EA) report, including an Environmental and Social Management Plan (ESMP) for the rehabilitation of the 30 kW Yandohun micro-hydropower station.  
Conduct public consultation meetings, and explain how public concerns have been addressed in the EA, |
| 2008: Local Farm Incorporated | Independent Services (Team of experts) | Lead Environmentalist:  
Conducted preliminary impact assessment for a World bank sponsored agricultural project in Compound 2, Grand Bassa County;  
Assessed and conducted Socio Economic Baseline Assessment for the World Bank Group: Multilateral Investment Guarantee Agency(MIGA) on behalf of Local Farm Incorporated  
Socio-economic survey in ten communities affected by the project;  
Soil and water in situ analysis of project terrain;  
Ecological assessment and analysis of project area;  
Presentation of findings and report to experts from UNIFEM;  
Submission of an Environmental Management Plan(EMP) to the Environmental Protection Agency(EPA) |
<p>| 2008: UNIFEM sponsored project for Ganta Concerned Women Group(GCWG) | Independent Services (Association of Independent Licensed Evaluators) | |
| 2008: Buchanan Renewable Fuels | Lead Environmentalist/Coordinator: | Monitor the discharge level of the Du River by conducting regularly discharged measurement; Conduct Socio-economic and Environmental Impact survey studies for inhabitants downstream of the Du River and those surrounding project terrain; Initiated and participated in various national and international stakeholders hearing on the propose renewable energy project; Prepared ESIA Report for the EPA |
| 2008: World Bank Sponsored Urban Work Project | Lead Environmentalist/Coordinator: | Conducted a three week impact/baseline study for Work Bank sponsored urban works in the city of Monrovia and its environs. The following parameters were covered as per the Term of Reference (TOR) of the project: Capture baseline information about the availability, accessibility and quality of services prior to the commencement of the works; Estimate incremental change in terms of coverage, accessibility, quality and affordability of each services; Capture any change in behavioral patterns in relation to the Bank’s Project. |
| 2008: Buchanan Renewable Fuels | Lead Environmentalist/Coordinator: | Monitor the discharge level of the Du River by conducting regularly discharged measurement; Conduct Socio-economic and Environmental Impact survey studies for inhabitants downstream of the Du |</p>
<table>
<thead>
<tr>
<th>Year</th>
<th>Project/Company</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Buchanan Renewable Energies (BRE)</td>
<td>Initiated and participated in various national and international stakeholders hearing on the propose renewable energy project;</td>
</tr>
<tr>
<td></td>
<td>Earthcons Inc.</td>
<td>Prepared ESIA Report for the EPA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lead Environmentalist/Coordinator:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assessed the baseline conditions of more than ten rubber farms/plantations to be felled and replanted;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Determined the environmental impact of the accessed road and equipment for the project;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepared Environmental Scoping Report for the Environmental Protection Agency (EPA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Served on the geo-technical team to conduct geo-technical investigation including soil testing analysis for the construction of the new U. S. Embassy Complex in Monrovia.</td>
</tr>
<tr>
<td>2005</td>
<td>Schnabel Engineering North (Washington D.C.)</td>
<td>Conduct investigatory/observatory surveys offshore the Lofa River for the purpose of preparing an Environmental Management Plan (EMP). The work includes collection and analysis of water and soil samples to determine baseline conditions prior to project commencement, so as to determine appropriate mitigation measures and post project environmental restoration.</td>
</tr>
<tr>
<td>2005</td>
<td>Subsea Resources DMCC</td>
<td>Assessment on baseline soil condition in which the following were analyzed:</td>
</tr>
<tr>
<td></td>
<td>Earthcons Inc.</td>
<td>• Soil pH, particle size analysis, and metals in the soil such as Cl, So₃ etc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Surface &amp; ground water quality monitoring to determine pH, turbidity,</td>
</tr>
<tr>
<td>2005</td>
<td>Itelgem Mining</td>
<td>River and those surrounding project terrain;</td>
</tr>
<tr>
<td>Year</td>
<td>Company/Institution</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>---------------------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| 2005: Kpo Resources | Earthcons Inc. | Conducted baseline studies/survey on the existing environment in which the following perimeters were analyzed:  
- The ecological environment which included assessment on the threatened and or endangers tree and animal species. At the end of the assessment a major location was discovered with the IUCN Red List species: Heriteria utilis (Niangon). To date this area has been reserved even during operation. |
| 2004 | Center for Sustainable Energy Technology (CSET) | **Section Head:**  
Assessment of energy sources, services and consumption pattern in Liberia;  
Monitoring, evaluation and reporting on these consumption patterns. |
<table>
<thead>
<tr>
<th>Date</th>
<th>Location, Country</th>
<th>Event Description</th>
</tr>
</thead>
</table>
| June 2009| Monrovia, Liberia | Environmental Evaluator Training & Licensure, Environmental Management Compliance Group (LIC) USA in collaboration with the Environmental Protection Agency -Liberia (EPAL) (Phase II) The training involved detail theoretical knowledge, case studies and field investigations in the following areas:  
  - Detail Environmental Impact Assessment (EIA)  
  - Environmental Management System (EMS)  
  - Environmental Management System Audit  
  - Occupational Health and Safety Management System (OHSMS)  
  - Environmental Health and Safety (EHS) |
| May 2007 | Monrovia, Liberia | Environmental Evaluator Training & Licensure, Environmental Management Compliance Group (LIC) USA in collaboration with the Environmental Protection Agency -Liberia (EPAL) (Phase I) Study waste disposal mechanism Investigatory assessment:  
  - ecological environment  
  - surface & ground water monitoring and analysis  
  - Storage tank and leaking storage tank and their impacts on the environment  
  - EIA in the forest sector  
  - EIA in the mining sector |
### Volunteer

<table>
<thead>
<tr>
<th>Period</th>
<th>Organization</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2006</td>
<td>Forestry Development Authority</td>
<td>Participated in raising awareness on tree planting exercises; Participated in the planting of trees on national tree planting day</td>
</tr>
<tr>
<td>2000-2004</td>
<td>Community support Morris Farm Community</td>
<td>Liaise with the local authorities and members of the community for identification and support of community developmental projects; Supported young adults seeing values within themselves to undertake meaningful venture in their lives and the community</td>
</tr>
</tbody>
</table>

### SKILLS

- A self starter
- Leadership ability
- Computer literate: Word, Excel, PowerPoint, etc.

Theoretical and practical field experiences in the usage of the following environmental equipment:

- Global Positioning Satellite (GPS)
- Vale port Water discharge measurement
- Weather Station
- Horiba Water quality testing equipment

### Field/Area of Environmental Experience

**Mining:**

- Gold
- Diamond
- Barite
- Rock Quarry
Agriculture
Industrials
Construction (road, and buildings)
Logging
Socio-Economic and Baseline Impact Assessment
E. Abraham T. TUMBEY JR-BSc

Email: abtumbey@yahoo.com/info@greenconsliberia.com
Tel:+ (231) 077013104/06530870

March, 2010

CURRICULUM VITAE
Director-Operations & Technical Services/Environmental & Social Impact Specialist
* EPA Licensed ESIA Evaluator
* BSc-Biology, Certs

Competencies:
- Solid experience in project planning, organization and management;
- Experience in survey design and administration in rural and urban setting;
- Mature personality and capability to handle sensitive situations;
- Excellent report writing skills;
- Ability to work under pressure and meet strict deadlines;
- Fluency in the English language with excellent communication skills;
- Team player and self starter;
- Knowledge of socio-economic, biodiversity and conservation issues in Liberia and the Mano River Union
- Experience in using environmental field gadgets: GPS, compass, gas meter, water monitor, noise meter etc. Solid experience in sampling activities for air, water, soil
- Almost 10 years of solid experience in field work in all of the 15 counties in Liberia, including highly inaccessible terrains.
- Experience in risks assessment, vulnerability and climate change adaptation issues
- Excellent Computer knowledge: Microsoft Words, MS Excel, MS PowerPoint, SPSS, Solinst Level Logger & Data Logger, Photoshop, internet & E-mail etc.
- Open to change and new information.

Strength : Self Confident, ethical, hardworking and fast learner

Academic Education

<table>
<thead>
<tr>
<th>Year</th>
<th>School</th>
<th>Achievement</th>
<th>Course/Study Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>University of Liberia Capitol Hill, Monrovia</td>
<td>BSc</td>
<td>Biology major, Chemistry minor</td>
</tr>
<tr>
<td>1996</td>
<td>WVS Tubman High 12th St, Sinkor, Monrovia</td>
<td>Diploma/WAEC Cert. Div. I</td>
<td>Secondary Education</td>
</tr>
</tbody>
</table>

Technical Training

<table>
<thead>
<tr>
<th>Year</th>
<th>School</th>
<th>Achievement</th>
<th>Course/Study Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>FAO/GOL</td>
<td>Certificate</td>
<td>Introduction to Polymer Science &amp; Rubber Technology</td>
</tr>
<tr>
<td>2006</td>
<td>Alpha Computer School Keamaxx Training Services 17th St, Sinkor, Monrovia</td>
<td>Certificate</td>
<td>Administration &amp; Office Work (Office Make Up, Systems and procedures, Tools &amp; Techniques, Decorum, Planning &amp; Organization, Office Equipment)</td>
</tr>
</tbody>
</table>
### Education

<table>
<thead>
<tr>
<th>Year</th>
<th>Institution</th>
<th>Certificate</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Alpha Computer School Keamaxx Training Services 17th St, Sinkor, Monrovia</td>
<td>Certificate</td>
<td>Customer Care Services (Managing Customer Care &amp; Expectation, Strategies &amp; Techniques)</td>
</tr>
<tr>
<td>1999</td>
<td>Grassroots Development Agency (GRADA)</td>
<td>Certificate</td>
<td>Socio-economic survey design, planning and implementation (PRA, REFLECT)</td>
</tr>
<tr>
<td>1999</td>
<td>Liberia Data Research Inst 10th St, Sinkor, Monrovia</td>
<td>Certificate</td>
<td>Electronic Data Processing (Electronic Spreadsheet, Database Management, Basic Accounting,)</td>
</tr>
</tbody>
</table>

### Other Training Experience

<table>
<thead>
<tr>
<th>Year</th>
<th>Host Institution</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>EPA/ GEF/UNEP Liberia</td>
<td>Workshops-Multidisciplinary Integrated Assessment” (Cost-Benefit Analysis, Multi-criteria Analysis. Participatory Rural Appraisal, GPS</td>
</tr>
<tr>
<td>2005</td>
<td>EPA/ GEF/UNEP Liberia</td>
<td>Workshop on Green House Gas Inventory/Vulnerability &amp; Adaptation Assessment on Climate Change.</td>
</tr>
<tr>
<td>2005</td>
<td>EPA/ GEF/UNEP Liberia</td>
<td>Workshop on Prioritization of Adaptation Measures for Least Developed Countries (Member NAPA Steering Committee)</td>
</tr>
<tr>
<td>2005</td>
<td>IUCN/Search for Common Grounds</td>
<td>Enhancing Civil Society Awareness &amp; Engagement in Forest Concession &amp; Review</td>
</tr>
<tr>
<td>2005</td>
<td>Sustainable Development Inst.</td>
<td>Reforming Liberia’s Forest Sector to Improve Law Enforcement &amp; Governance</td>
</tr>
<tr>
<td>2000</td>
<td>USAID/CRS</td>
<td>Introduction to Environmental Impact Assessment for USAID Mission Partners</td>
</tr>
<tr>
<td>1996</td>
<td>Liberia Educators Allied for reconstruction &amp; Development (LEADER)</td>
<td>“Capacity Building workshop” (Project Proposal Design, Feasibility Studies &amp; Implementation. Survey Design &amp; Methodology, Basic</td>
</tr>
</tbody>
</table>
Career Experience

<table>
<thead>
<tr>
<th>Year</th>
<th>Entity</th>
<th>Position</th>
<th>Duties/Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Green Consultancy Inc</td>
<td>Director-Operations/Tech. Services-Environmentalist</td>
<td>Responsible for the planning and management of all operational and technical aspects of the firm including resources, equipment, Standard Operating Procedures and personnel required for ESIA projects. Develop ESIA proposals, design and implement ESIA projects, prepare timely project reports; manage health/safety plan, work plan and QA/QC Plan. Provide expertise in the area of biological and social assessment and monitoring.</td>
</tr>
<tr>
<td>2006-2009</td>
<td>Earthcons Inc</td>
<td>Environmentalist</td>
<td>Gathering samples (soil/water), data, UTM coordinates and information relevant to Environmental Impact Assessment. Prepare reports on field activities, prepare work plan and supervise activities for field assistants and perform other duties as required.</td>
</tr>
<tr>
<td>2004-2006</td>
<td>Roberts Int’l Airport</td>
<td>Secretary</td>
<td>Supervise and coordinate activities, staff and equipment in the office of the Deputy General Manager for Operation &amp; Technical Services. Manage office documents and email account; Prepare office budget and manage petty cash. Supervise fuel management / distribution and produce monthly fuel consumption statistics. Arrange and coordinate hotel reservation/booking for airport guest. Arrange appointments and carry on other administrative functions as may be required.</td>
</tr>
<tr>
<td>2002-2004</td>
<td>Society Against Env. Degration (SAED) Monrovia, Liberia</td>
<td>Program Asst.</td>
<td>Provide technical support in the design and management of environmental awareness, monitoring and advocacy programs and projects for marine turtles, birds and coastal wetlands; perform other duties as may be assigned by the Executive Director.</td>
</tr>
<tr>
<td>2002-2004</td>
<td>Grassroots Development. Agency Monrovia, Sinoe, G. Bassa</td>
<td>Field Supervisor</td>
<td>Management and supervision of Field Officers; monitoring community development projects and designing strategies for adjustment where necessary; conducting surveys and collating data from field reports. Prepare monthly field activity summaries and perform other duties as assigned by the Program Manager.</td>
</tr>
</tbody>
</table>

Highlight of ESIA Work Credentials

<table>
<thead>
<tr>
<th>Client</th>
<th>Sector</th>
<th>Company</th>
<th>Project Location</th>
<th>Project</th>
<th>Activity</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>Project Name</th>
<th>Activity Type</th>
<th>Consultant</th>
<th>County/Region</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sime Darby Plantation Liberia</td>
<td>Agriculture</td>
<td>GREENCONS</td>
<td>Bomi/ Grand Cape County</td>
<td>Water sampling, weather data sampling, air quality/noise sampling, ecological survey, socio-economic survey, data analysis, report writing</td>
</tr>
<tr>
<td>Explorex Overseas Limited</td>
<td>Mining Exploration</td>
<td>GREENCONS</td>
<td>Gbarpololu County</td>
<td>Review of project plan; Public consultation, baseline survey (soil, water, ecology), data analysis, report writing</td>
</tr>
<tr>
<td>Euro Liberia Logging Company</td>
<td>Logging</td>
<td>GREENCONS</td>
<td>Grand Gede/RiverG ee County</td>
<td>Water sampling, weather data sampling, air quality/noise sampling, ecological survey, socio-economic survey, data analysis, report writing</td>
</tr>
<tr>
<td>UNIFEM</td>
<td>Agriculture</td>
<td>Independent Consultant</td>
<td>Nimba County</td>
<td>Public consultation, baseline survey (soil, water, ecology), data analysis, report writing</td>
</tr>
<tr>
<td>Buchanan Renewable Energy Power</td>
<td>Biomass Power Plant</td>
<td>EARTHCONS</td>
<td>Margibi County</td>
<td>Water sampling, discharge measurement, weather data sampling, air quality/noise sampling, ecological survey, socio-economic survey, data analysis, report writing</td>
</tr>
<tr>
<td>New Liberty Gold Mine</td>
<td>Mining</td>
<td>EARTHCONS</td>
<td>Grand Cape County</td>
<td>Water sampling, discharge measurement, weather data sampling, air quality/noise sampling, ecological survey, socio-economic survey, data analysis, report writing</td>
</tr>
<tr>
<td>Buchanan Renewable Energy</td>
<td>Agriculture (rubber harvesting)</td>
<td>EARTHCONS</td>
<td>Grand Bassa County</td>
<td>Socio-economic and ecological baseline study, public consultation, data analysis, report writing</td>
</tr>
<tr>
<td>BSGR</td>
<td>Mining</td>
<td>EARTHCONS</td>
<td>Bong, Bassa, Margibi County</td>
<td>Public Awareness, socio-economic and ecological data collection; data, analysis; report writing</td>
</tr>
<tr>
<td>Hummingbird Resources</td>
<td>Mining Exploration</td>
<td>EARTHCONS</td>
<td>Sinoe County</td>
<td>Project plan review, public consultation, ecological survey, data analysis, report writing</td>
</tr>
<tr>
<td>World Bank/UNDP</td>
<td>Development</td>
<td>EARTHCONS</td>
<td>Montserrado County</td>
<td>Socio-economic baseline survey, data analysis, report writing</td>
</tr>
<tr>
<td>Company/Project</td>
<td>Agriculture</td>
<td>Consultant Type</td>
<td>County</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
<td>------------------</td>
<td>--------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Local Farm Inc</td>
<td>(rice/oil palm)</td>
<td>Independent Consultant</td>
<td>Grand Bassa County</td>
<td>Environmental &amp; Social Impact Assessment</td>
</tr>
<tr>
<td>Hamidou Gnan</td>
<td>Construction</td>
<td>Independent Consultant</td>
<td>Montserrado County</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>Morris American Rubber Company</td>
<td>Rubber Processing</td>
<td>Independent Consultant</td>
<td>Margibi County</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>Lee Group Enterprise</td>
<td>Rubber Processing</td>
<td>Independent Consultant</td>
<td>Bong County</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>UNEP/NAPA</td>
<td>Climate Change</td>
<td>Independent Consultant</td>
<td>Maryland County</td>
<td>Researcher</td>
</tr>
</tbody>
</table>

Professional Writings & Presentations


Tumbey, E. Abraham. “The Causes, Effects, Stigma & Treatment of Epilepsy”- (Published) Bio-Seminar Presentation, University of Liberia, 2004

Tumbey, E. Abraham. “The Impact of Climate Change on Five Communities in Liberia” (Published)-Thesis for B.Sc Biology, University of Liberia, 2005


Tumbey, E. Abraham. “The Environmental Hazards of the Improper Disposal of Polythene Water Bags in Monrovia” (Published), Analyst Newspaper, 2007

Biodata:

- Age: 32
- Birthday: 28th November 1978
- Nationality: Liberian
- Religion: Christian
- Marital Status: Married
- Height: 5.6”
- Weight: 70 kg
Annex 10: Onsite Weather Data
GPS Coordinate: 0351347/0898137