

WEST NILE ELECTRICITY SUPPLY PROJECT

ENVIRONMENTAL IMPACT STATEMENT (EIS) REPORT

FOR THE

PROPOSED OLEWA HYDROPOWER PROJECT

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Finally, the EIA team would like to thank all the local council officials of Arua and the communities in the project for their unreserved cooperation.

However, while acknowledging the contributions and support received during the course of the study, the EIA team assumes full responsibility for the omissions and errors contained in this EIS report.

ABBREVIATIONS AND ACRONYMS

AFFREI	African Rural Renewable Energy Initiative
CAO	Chief Administrative Officer
CEFORD	Community Empowerment for Rural Development
DEO	District Environment Officer
DRC	Democratic Republic of Congo
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMA	Environment Management Associates
EMR	Electro-magnetic Radiation
ERT	Energy for Rural Transformation
GoU	Government of Uganda
IDA	International Development Association
IFC	International Finance Corporation
km	Kilometres
km ²	Square Kilometres
km/s	Kilometres per second
LC	Local Council
M ²	Square Kilometres
M ³ /s	Cubic Metres per second
MW	Megawatt
NEMA	National Environment Management Authority
NES	National Environment Statute
OPIC	Overseas Private Investment Corporation
RDC	Resident District Commissioner
ToR	Terms of Reference
UEB	Uganda Electricity Board
UWA	Uganda Wildlife Authority
WB	World Bank
WNES	West Nile Electricity Supply

EXECUTIVE SUMMARY

The growing demand for electricity in rural Uganda is currently not being met by the rate of supply. Electricity supply has since independence been the domain of the Uganda Electricity Board (UEB). Government is presently shifting its policy of supplying electricity by UEB to companies with the capability and required experience for supply of electricity to the public, in order to correct the inability of UEB. The World Bank (WB) is providing assistance through the Energy for Rural Transformation (ERT) project as part of the large initiative entitled African Rural Renewable Energy Initiative (AFRREI). The objective of the programme is to facilitate private sector involvement in generating and supplying electricity as a long-term rural development strategy. The proposed Olewa Hydropower Scheme falls in this category and has attracted financial support through the programme.

However, before the project is developed it is mandatory that an environmental impact assessment study has to be carried out. The objective of the study is to assess the potential impacts that could result from the development of the project. The study which conform to GoU and World Bank guidelines on environmental and social safeguards involved a review of studies conducted earlier especially the M&E Associates study, site visit and consultation with various stakeholders. The study team evaluated the baseline data of the project area, assessed potential impacts and made recommendations to minimize the impacts.

The project is a run-of-river scheme on River Enyau in Arua district in North Western Uganda. The initial project will be the cheapest of all other options, and other components can be added at a later date to build up to the full potential. The first project will be with installed capacity of 1.4 MW. Output will be 0.35MW (raised by daily regulation to 0.7 MW) and 1.4 MW for 75% of the year. The maximum abstraction flow will be 2.8 m³/s with a head of 60 m.

The project will involve the construction of a flow abstraction weir about 60 m elevation above Olewa falls; construct settling chamber adjacent to the weir structure; provide a low-pressure water conveyance system from the intake to a location that results in the shortest length of penstock; provide two penstocks to the powerhouse; construct a powerhouse complete with all the required plant and equipment; provide a transmission line from the power site to Arua Town and provide the plant and

equipment to connect up into the existing distribution system. Other aspects of the project include the construction of access road from Burua Church and workers' camp. This study was based on the analysis of potential impacts that will result from the above project description.

Indeed, there is a considerable demand for a reliable 24-hour power supply in the West Nile region, largely because of the great potential for economic development. The present local grids are supplied by diesel generators.

The project will benefit a cross section of society including employment for non-skilled persons from the local communities, improved infrastructure and emergency of a new vibrant economy.

The project is located 12 kilometres from Arua Town in the counties of Terego and Maracha but specifically in the sub-counties of Katrini and Aivu on River Enyau. There is little as far as industrial activities are concerned in the vicinity of the site and the resultant air and water quality is good. Vegetation and wildlife were considered as having a low value along with the aquatic ecosystem and biodiversity for the region. This is primarily because the area is highly cultivated and inhabited along both banks of the river by native Lugbara people. The majority are subsistence farmers practising customary land tenure and limited crop rotation. Tobacco is the single most important cash crop grown by a few farmers in the project area. Other economic activity in the vicinity is petty trade. Services and infrastructure are poor and inadequate. As a result the local population has welcomed the project as a stimulant of employment opportunity as well as infrastructural development.

There are a number of impacts to consider. The most important are changes in river flow, water quality and aquatic ecosystem as a result of reduced flow between the intake channel/canal and the outlet and general change in water conditions and characteristics. Impacts on vegetation, wildlife and other environmental conditions are considered minimal and insignificant.

Impacts on human environment that warrant consideration are the loss of land and agricultural production due to permanent and temporary project structure and activities in the Direct Impact Zone. It is estimated that about 50 acres of farmland will be lost due to the project work. However, no homestead will be lost and so there will be no

relocation of people due to project development. Health conditions are expected to deteriorate due to possible increase in water-borne diseases and threat of Sexually Transmitted Diseases (STDs), including HIV/AIDS due to workers' camp and population influx during construction phase. Finally, the visual and aesthetic aspects of the rapids along the stretch of the Enyau River will be lost for much of the year.

The potential benefits of the project are many. Clearly the demand for a regular and reliable supply of electricity to Arua district is most welcome and would lead to considerable economic development as well as social improvements touching on very many aspects of people's lives. There are great anticipations for investments due to the planned project development.

Finally, a number of mitigation measures have been put in place to safeguard impacts of the project on the natural and socio-economic environment. These include restrictions on construction activities, erosion prevention, speed limits for vehicles, disposal of waste products, pollution, fuel storage and landfill. In addition, preventive health programmes and restriction on agriculture around the powerhouse and canal are recommended.

Comprehensive compensation for loss of agriculture land and other property should be carried out such that affected individuals/families do not suffer due to project development. Project development should result in improved livelihoods of the communities in the project area and in the region.

1. INTRODUCTION

1.1 BACKGROUND

The West Nile Region comprises the districts of Nebbi, Arua, Yumbe, Moyo and Adjumani. Arua and Yumbe have the largest population (estimated 850,000), followed by Nebbi (estimated 450,000 today), Moyo and Adjumani (estimated 110,000 each). Arua Municipality is the largest urban area in West Nile, and is one of Uganda's fastest growing urban areas. Paidha Towncouncil is the second largest urban centre in the Region, and the largest in Nebbi District, with an estimated population of over 20,000 people by 2001. Paidha Towncouncil is the next largest urban centre in the region, with an estimated population of 12,500, followed by Nebbi Town Council at just under 10,000 inhabitants.

The West Nile Region has the potential to be one of Uganda's most productive agricultural areas. Prior to 1979, it was one of the country's most developed areas; it is now rapidly recovering from decades of turmoil and neglect. It has several agro-ecological zones, ranging from dryland savannah to highland tea and coffee zones. Historically coffee, tea, tobacco, cotton, groundnuts and sesame (simsim) were the most important cash crops grown in the region; at present, coffee and tobacco production are up. The lack of adequate and reliable electricity supply has seriously constrained the region's development, particularly in the agro-processing fields (e.g., coffee, cotton, tea, grain milling etc.).

The Uganda Electricity Board (UEB), currently undergoing privatization, supplies some 840 customers in Arua, Nebbi and Paidha in the West Nile region, split by sector comprising roughly 60% business/commercial, 15% institutional, and 25% residential consumers. UEB has five diesel generators, four in Arua and one in Nebbi, with a current operating capacity of 776 kW. UEB operates a distribution grid in Arua supplying some 700 consumers, and very small distribution centres in Nebbi (some 80 consumers) and Paidha (some 30 consumers), with the latter two centres connected by a 24 km 33kV line.

Power from UEB is available only for four hours per day, between 7-11 pm. This supply is erratic and UEB estimates that it sheds over 400 kW each evening to grid-

connected consumers. One component of the unmet demand is from the estimated 1,000 registered business establishments in Arua, Nebbi And Paidha towns. Arua is by far the most important economic centres in northern Uganda, although Paidha is the regions's fastest growing economic centres.

The Electricity for Rural Transformation (ERT) Demand Surveys conductd by a local Ugandan and international team found that there are currently over180 independent diesel generating sets (gensets), and a further 42 medium to large diesel mills (grain) with a total installed capacity of 2.86 MW, generating over 7.65 GWh per year. West Nile's urban consumers spend over US\$ 6.5 million per year on petroleum fuels to cover costs of lighting and power.

In order to meet the growing demand for rural electricity , the Government of Uganda (GoU) and the Uganda Electricity Board (UEB) have recently introduced measures to decentralise electricity generation as part of a strategy to correct serious shortfalls in performance. With one of the lowest per capita electricity consumption in the world (62 Kwh/year) and with approximately 5% of households having access to grid – supplied electricity, the present rate of additional customers of 10,000 per year is not sufficient. With a population growth of about 3% per year, 90,000 customers are required merely to retain the present low level of electricty consumption (NORPLAN, 2000).

The new Electricity Law provides for measures of 'unbundling' UEB and encourages private participation in the growing power market. This commercially-oriented approach could have important consequences for rural electrification. The Government of Uganda (GoU) has sought the assistance of the World Bank (WB) in implementing a new rural electrification strategy. This strategy consists of the following elements:

- level playing field for private sector participation;
- enabling regulatory framework;
- cost recovery and cost-based tarrifs; and
- subsidy transfer and financing mechanism.

Energy for Rural Transformation (ERT) for Uganda is under a large WB initiative known as African Rural Renewable Energy Initiative (AFRREI) whose objectives include, among others, the facilitation of private sector energy development schemes in rural

Africa and to utilise these schemes as a catalyst for overall rural transformation. The Electricity for Rural Transformation (ERT) Programme is a proposed 10-year loan programme that aims to provide rural households with reliable supplies of electricity and the benefits that come with it. In addition, rural enterprises like Pacific Inn in Arua town which spends about Ushs 500,000= per month for operating a private diesel generator, should receive assistance in switching over from other traditional sources of energy. Each programme will have capacity building aspects and conform to GoU's and WB's environmental and social standards. These projects are rural electrification in general terms. They fall into category 'B' of the WB's environmental assessments; that is, projects with some impacts on the social and biophysical environment.

The first phase of the ERT programme will have the following components:

- main grid-related power distribution and generation, (that is connecting rural areas to the main grid);
- independent grid systems in isolated areas;
- individual or institutional solar photovoltaic systems (PVs) in dispersed areas; and
- pilot schemes in scaling up traditional energy uses.

The West Nile Electrification project will be the first integrated power utility concession to be granted to a private investor in Uganda under the Power Sector Restructuring and Privatization Strategy (PSRPS) in which the government is unbundling the Uganda Electricity Board into transmission and generation businesses. This will start initially with the electrification of Arua and Nebbi Districts, where the national state owned power company, UEB, owns and operates small grids supplied by diesel generators.

The concession will oblige the developer to build, own and operate a vertically integrated power system that will involve the construction of the Paidha-Nyagak hydro power station (about 5 MW run of river potential) on the River Nyagak and, later during Phase 1 of the ERT, a hydropower facility at Olewa, 20 km from Arua Municipal township. These hydropower generation facilities will supply Paidha and Nebbi Municipalities through an existing 33 kV sub-transmission line (approximately 22 km from Paidha to Nebbi) through a distribution and sales concession that will also operate the distribution networks in Paidha, Nebbi and Arua. The Government of Uganda (GoU) will inter-connect Nebbi and Arua to integrate the system through a 33 kV sub-transmission line that is anticipated to run from Nebbi to Arua via Okollo and Bondo,

some 80 to 84 kilometres. At the time this study was conducted, the sub-transmission line had reached Bondo from Arua and only about 50 km of construction are left to reach Nebbi.

The concession will require the strengthening, rehabilitation and expansion of the Arua and Nebbi distribution networks, presently served by small diesel generators. These distribution centres will be supplied via the 80-100 km long 33kV transmission line along the main Highway(through Okollo and Bondo) between Arua and Nebbi townships. During the initial two years or so, until the mini-hydro plant has been constructed, one highly efficient diesel turbine of 1.5 MW capacity will be installed in Arua, while another of 1.0 MW capacity will be installed in Paidha/Nebbi. This will provide more reliable, near-around the clock power to the three load centres while the 33 kV sub-transmission line is being constructed between Arua and Nebbi and while the first HPP is being constructed in Nyagak, Paidha (between 18 months and two years estimated construction time). These will provide highly reliable and considerably cheaper power compared both to the current UEB generation, and the more than 200 private diesel and petrol generating sets (gensets) and diesel driven mills in the three townships. Later, these two large diesel gensets will serve as both a reserve(for scheduled and unscheduled down time) and for peaking.

The sheme will be stand alone, and will not be connected to the national grid until such time that the market load builds up to the point where it exceeds the installed capacity, and when security between Gulu and West Nile so warrants. Additionally, the extension of the main inter-connected grid serving central, eastern and south western Uganda is in the process of privatization.

The WNES scheme therefore consist of:

- The sale of the Uganda Electricity Board's (UEB) generation and distribution assets in Arua and Nebbi districts of West Nile;
- The construction of an 80 km sub-transmission line between the towns of Nebbi and Arua, to be paid for by the Government of Uganda;
- The installation of two new efficient diesels (1.5 MW and 1.0 MW) as both base load during the construction of the Nyagak (Nebbi District) hydropower plant, and later as peaking plant;

- The construction during Phase I of the ERT of a 5.1 MW HPP (run-off-river scheme) at the Nyagak site in Nebbi District, and, two years later, the construction of a 1.5 MW (run-off-river scheme) plant in Olewa, Arua District;
- The upgrading and extension of the existing distribution networks in Paidha and Nebbi townships and Arua municipality, the largest load centre in the West Nile Region.

This study analyses the potential impact on the biophysical and human environment that will be created by the construction of the predetermined option of a 1.5 MW (run-off-river scheme) plant at Olewa on River Enyau some 20 km south of Arua town. The Olewa Hydropower Project and construction of sub-transmission lines to serve Arua and Yumbe districts fall under the second component of the ERT programme. A bidding process for the selection of a private developer is underway being managed by the Electricity Regulatory Authority (ERA).

1.2 Objectives of the Study

According to the Terms of Reference (TOR) of this study, the objectives are among others to ensure that the investments for the second phase of the ERT comply with GoU and WB environmental and social safeguard policies. In addition, recommendations for a framework for ensuring compliance of future projects within ERT programme will be worked out based on reviews of this and other studies in future. This particular study involves an assessment of the Olewa Hydropower Project in relation to GoU standards for environmental management, legislation, regulations and administrative framework (NEMA 1995) and WB's 10 Environmental and Social safeguard policies. At least one Environmental Impact Study has been carried out in 1998 by M & E Associates, Consulting Engineers was part of a Feasibility study, for the Olewa project. Much of this report reviews and builds upon the Dutch study.

1.3. EIA Team

The EIA study was carried out by a multidisciplinary team of consultants with very rich background in environmental assessments in Uganda and in the region, and are quite familiar with the World Bank projects and standards.

The team consisted of the following:-

- Dr. Yakobo Moyini – Team Leader.
- Dr. Christine Dranzoa – Ecologist (terrestrial)
- Dr. Natal Ayiga – Sociologist
- Mr. Henrik Lindhjem - Economist
- Mr. Luka Agwe – Socio-economist
- Dr. Akusa Darlington – Public Health
- Mr. Isaiah Owunzi – Ecologist (aquatic)
- Mr. Stephen Okuta - Hydrologist

1.4. Methodology

Three main methods were used by the consultants in formulating this report:

- literature review of reports, documents and other relevant information about the project;
- site visit, including the project area (i.e. the proposed powerhouse, penstock, transmission line and access road locations, and camp sites) and adjacent towns of Koboko, Yumbe and Arua that would benefit from the project; and
- consultations with district officials, local leaders and the people who will be affected by the project at the site.

2.0 POLICY, LEGAL AND INSTUTIONAL FRAMEWORK

2.1 Policies

This chapter discusses the policy, legal and administrative framework within which the TOR for the EIA for the Nyagak Hydropower Project has been prepared. National or local and international environmental requirements and guidelines are discussed along with relevant international environmental agreements ad conventions.

2.1.1. National Environment Management Policy

The *National Environment Management Policy* (NEMP) was adopted by Cabinet in 1994. Its overall goal is the promotion of sustainable economic and social development that enhances environmental quality without compromising the ability of future generations to meet their own needs. One of the strategies identified to achieve this goal is Environmental Impact Assessment. The policy clearly states that an Environmental Assessment should be conducted for any policy or project that is likely to have adverse impacts on the environment. This statement is further embedded in the *National Environment Statute* No. 4 of 1995 which makes EIA a legal requirement for eligible projects, policies and programmes.

2.1.2 Energy Policy

A draft *Energy Policy* has been formulated for Uganda and awaits Cabinet approval. The policy, once approved, will emphasise sustainable and environmentally begin development. At the sectoral level, the policy further strengthens the provisions of the *National Environment Management Policy 1994* for environmental impact assessments.

2.1.3 The National Policy for the Conservation and Management of Wetland Resources 1995

The *National Policy for the Conservation and Management of Wetland Resources 1995* was put in place to curtail the rampant loss of wetland resources and ensuring that benefits from wetlands are sustainable and equitably distributed to all people of Uganda. Among others, and in line with the *National Environment Management Policy*

1995, the wetland policy calls for the application of environmental impact assessment procedures on all activities to be carried out in a wetland to ensure that wetland development is well planned and managed.

2.1.4 Water Resources Policy 1995

The overall water resources policy objective is to sustainably manage and develop the water resources in a coordinated and integrated manner so as to secure/provide water of an acceptable quality for all social and economic needs. To further elaborate, the *National Water Policy* states as follows:

- “the first priority in water resources allocation will be the provision of water in adequate quantity and quality to meet domestic demands; and
- “allocation of water to meet irrigation, livestock, industrial and other demands will be done considering the economic, social and environmental value of water”.

The foregoing statements mean that meeting the demand for domestic water is the first priority. Then, when it comes to water for other uses, prioritisation is dependent on several factors and can be made the subject of tradeoffs between various social economic and environmental considerations.

Finally, the policy provides that conditions for, and impact of, water supply project should be assessed considering demographic, environmental and health aspects in accordance with stipulation for carrying out environmental impact assesment as given in the *National Environment Management Policy 1994* and prepared within the NEMA guideliens ad regulations.

2.2 Legal and Regulatory Framework

2.2.1 The Uganda Constitution, 1995

The Uganda Constitution of 1995, Article 39 and 41 provides that everyone has a duty to maintain and enjoy a sound environment. Every person in Uganda has a right to a healthy environment and as such can bring action for any pollution or disposal of wastes. Chapter three section 245 stipulates that Parliament shall by law provide

measures intended to protect and preserve the environment from abuse, pollution and degradation.

2.2.2 National Environment Statute and Regulations

The *National Environment Statute, 1995* provides tools for environmental management that hitherto had not been deployed, including EIAs. The Statute imposes a mandatory duty on a project developer to have an environmental impact assessment conducted before embarking on a project.

The EIA Regulations, 1998 specifies the types of projects to be subjected to EIAs. An EIA should be conducted for planned activities that may, are likely to, or will have significant impacts on the environment. The EIA required should be appropriate to the scale and possible effects of the project, and therefore the Environment Statute and the Regulations recognise three levels of EIA:

- an environment impact review shall be required for small scale activities that *may* have significant impact;
- environmental impact evaluation for activities that are likely to have significant impacts; and
- environmental impact study for activities that will have significant impacts.

Determination of the level of the EIA required is done through the screening stage, and the EIA Guidelines provide a checklist where environmental factors potentially affected are listed. This is a useful tool in the first stage to see which category the project falls under.

2.2.3 Electricity Regulation

The *Electricity Act of 1964*, which provides for the legal framework for operation, further empowers UEB to supply electricity to or take electricity away from any person inside or outside Uganda was reviewed and the present *Electricity Act 1999* removed the monopoly of UEB. Previously, the Electricity Act, Cap 135 established UEB as a Statutory power to exercise corporate and monopoly functions relating to the

generation, transmission, distribution and supply of electricity and gave the UEB licensing and other regulatory functions.

The *Electricity Act 1999* created the *Electricity Regulatory Authority (ERA)* which is supported by a Secretariat. The Act also allows for the entry of private players in the electricity sector through a detailed licensing mechanism overseen by ERA. The Authority has the power to issue licences to any person intending to participate in generation, transmission and distribution of electricity. The sale, import, and export of electricity are also licensable.

However, this *Electricity Act 1999* is not yet fully operational until divestiture of Uganda Electricity Board (UEB), which is currently under the Parastatal Monitoring Unit of the Ministry of Finance , Planning and Economic Development is complete.

In the case of the Olewa Hydropower Project any Independent Power Producer (IPP) can be licensed to generate and sell power in accordance with its implementation Agreement and the Power Purchase Agreement the company will have with the Government of Uganda and the regulator. The *Electricity Act 1999* requires that the IPP pays royalty to the District Local Government in which the generating station is located.

Before the *Electricity Regulatory Authority (ERA)* issues a license for any of the activities supposed to be licensed under the Electricity Act, it shall require that the applicant first produces a certificate of approval from NEMA.

2.2.4 Water Act

The *Water Act, 1995* (GoU, 1995b) provides for the use, protection and management of water resources and supply. The objectives of the statute are to promote the national management and use of waters of Uganda through the introduction and application of standards and techniques, the coordination of all public and private activities that may influence water quality and quantity and to allow for the orderly development and use of water resources for such activities as generation of hydro-electric or geothermal energy.

2.2.5 Land Act 1998

The *Land Act 1998* provides for the ownership and management of land. It provides for four different forms of land tenure (customary, leasehold, *mailo* and freehold) and the procedure for applying for grant of any of these tenures. The Act provides that non-citizens of Uganda may only be granted leases not exceeding 99 years.

The Act *inter alia* provides that the construction of electric lines, construction of dams and hydro-power plants are public works and any person authorised to execute public works on any land may enter into mutual agreement with an occupier or owner of the land in accordance with the Act.

2.2.6 Local Governments Act 1997

The *Local Governments Act 1997* provides for the decentralisation and devolution of government functions, powers and services from the central to local governments and sets up the political and administrative functions of the latter. The *Electricity Act 1999* authorises the ERA to delegate some of its licensing functions to local governments - receiving royalties from the IPPs.

2.2.7 Town and Country Planning Act 1964

This act provides for the orderly and progressive development of land in towns and other rural areas of the country. It defines building operations to include the making accessible of electrical installation and development in relation to any land. Any placing of new poles for transmission and distribution of electricity and construction of substations have to comply with the provisions of this Act.

2.2.8 Investment Code Statute

The Investment Code Statute, sets out the procedure for an investment license and the kind of information to be included therein. It makes provision for the Investment Authority as a corporate body and distinguishes between foreign and non-foreign investors. The Code provides that investment in the energy conservation industry is priority and requires investor to perform an Environmental Impact Assessment for approval by NEMA before the project is implemented.

2.2.9 International Agreements

Uganda is signatory to and/or ratified several international agreements relating to the environment. Both global and regional agreements of potential importance are briefly discussed below:

The *United Nations Framework Convention on Climate Change (UNFCCC)* was ratified by Uganda in 1993. The objective of the UNFCCC is to regulate levels of greenhouse gas concentration in the atmosphere, so as to avoid the occurrence of climate change at levels that would harm economic development, or that would impede food production activities. One of the ways of doing this is for countries to work towards greater energy efficiency and, in the process, saving forests and vegetation (which serve as carbon sinks and reservoirs) and turning increasingly to the use of renewable sources of energy.

The *Convention on Biological Diversity (CBD)* has been ratified by Uganda. A major objective of the convention is to ensure the conservation of biological diversity and the sustainable use of its component parts.

The *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)* has been ratified by Uganda and seeks to ensure that the international trade in species of wild fauna and flora does not threaten the survival in wilderness of the species concerned. Species on the CITES lists are considered of conservation concerns.

Uganda has ratified the *African Convention on the Conservation of Nature and Natural Resources (1968)*; signed the *Protocol Agreement on the Conservation of Common Natural Resources (1982)*; and the *Lusaka Agreement of Co-operative Enforcement and Operations Directed at illegal Trade in Wild Fauna and Flora (1994)*.

2.3 Institutions

2.3.1 National Environment Management Authority (NEMA)

Under the *National Environment Statute, 1995* (GoU, 1995) the National Environment Management Authority (NEMA) is the principal agency in Uganda for the management

of the environment and shall coordinate, monitor and supervise all activities in the field of the environment (GoU, 1995). NEMA is under the Ministry of Water, Lands and Environment, and has a cross-sectoral mandate and is also to review and approve EIAs submitted to it.

NEMA has issued guidelines on EIAs (NEMA 1997), and the Environmental Impact Assessment Regulations (GoU, 1998) was approved by the Ugandan Parliament. The actual implementation of the EIA process remains a function of the relevant line ministries and departments, the private sector, NGOs and the general public.

The National Environment Management Authority (NEMA) is the institution responsible for overseeing and conducting all aspects of the environment and in particular the review of Environmental Impact Statement (EIS) reports.

NEMA reviews EIS reports in collaboration with relevant lead agencies. In the case of the Olewa Hydropower Project, the major lead agency is the Uganda Electricity Board (UEB) which falls under the Ministry of Energy and Mineral Development. Other lead agencies that would participate in the review are the Ministry of Lands, Water and Environment and in particular the Departments of Forestry, Land Administration and the Wetlands Programme; and the Directorate of Water Development.

2.3.2 Electricity Regulatory Authority

The Electricity Regulatory Authority issues licences for generation, transmission or supply of electricity. It is also provided with the authority to consider the need to protect the environment and conserve natural resources when granting such a licence. The application for a license is advertised in the gazette to inform the public and invite them to make objections if any on personal, environmental and other grounds, before granting of the application. The licence, after approval of application, is required to compensate any person affected for damage to the environment, wildlife, living conditions or property or for relocation due or caused in the course of the operations of the licence.

2.3.3 Directorate of Water Development (DWD)

The Water Statute, 1995 (GoU, 1995b) created the Directorate of Water Development which provides for the use, protection and management of water resources and supply.

The objectives of the statute are to promote the rational management and use of the waters of Uganda through the introduction and application of standards and techniques, the coordination of all public and private activities that may influence water quality and quantity and to allow for the orderly development and use of water resources including such activities as generation of hydro-electric or geothermal energy.

2.3.4 Town and Country Planning Board

The 1995 Uganda Constitution Cap 30 provides for the formation of the Town and Country Planning Board. This Board provides for the orderly and progressive development of land in towns and other rural areas of the country. It defines building operations to include the making accessible of electrical installation and development in relation to any land. Any placing of new poles for transmission and distribution of electricity and construction of substations would have to comply with the provisions of this Act.

2.3.5 District Level Institutional Structure

The district level institutional structure is described in this section as follows:

2.3.5.1 Arua District Administration

Olewa Hydropower Project is located on River Enyau, in the sub-counties of Katrini Aiiyu, and Yivu in Terego and Maracha Counties in Arua District. The district is created under the Local Governments Act 1997. Its top administration includes the Chairman Local Council Five (LC V) and the Chief Administrative Officer (CAO).

The Departments at the District level which are directly involved in the project as a whole include the District Environment Officer, the District Medical Officer, the District Fisheries Officer, the District Security Officer, the District Water Officer, Community Development Officer, District Forest Officer, District Agriculture Officer, District Education Officer, and District Engineer.

Although technical expertise for hydropower project may not exist among the district officials, their proximity to, and knowledge of, the project area facilitate their participation especially if they are requested by the Ministry of Energy and Mineral Development for technical input.

The Local Councils at the village level (LC 1 and LC 11) and the villagers are well organised. During the site visits, the LC officials mobilised villagers for consultations and they seem to have established good co-operative arrangements and therefore the capacity to deal with resettlement issues at the time of project implementation or even before construction work begins.

2.3.5.2 Private Sector and Civil Society Institutions

Interested private sector institutions and NGOs will be given an opportunity to participate in further studies. A number of NGOs exist in Arua District including CEFORD (Community Empowerment for Rural Development) a local initiative in the District that was identified in the project area. They are involved in social community development work. These and other NGOs have relevant experience in the district and could play an important role in carrying out some of the mitigation and monitoring activities, in particular those related to social, health and educational issues.

2.3.6 Donors and Financing Institutions

This EIA follows international EIA standards and procedures. It will therefore be possible, upon approval from NEMA, for developers to seek financing and donor support from private and government organisations.

The World Bank (IDA) has a range of relevant requirements and guidelines, including:

- Environmental Assessment Sourcebook (WB, 1999 a,b,c) and Updates (NO. 1 – 25).
- Operational Policies (OP), Bank Procedures (BP) and good practice (GP) 4.01, Environmental Assessment (WB, 1999a,b,c) replacing OD 4.00 and OD 4.01, WB, 1989a,b).
- Operational Policies (OP) and Bank Procedures (BP) 4.04, Natural Habitats (WB 1995 a,b)

- Operational Policies (OP) 4.07, Water Resources Management (WB, 1993a).
- Operational Directive (OD) 4.20, Indigenous peoples (WB, 1991d).
- Operational Directive (DO) 4.30, Involuntary Resettlement (WB, 1990a).

Similarly, the International Finance Corporation (IFC), which is the private sector arm of the World Bank Group, has adopted Environmental Social Safeguard Policies' which are quite similar to the requirements of the International Development Association (IDA) of the World Bank Group. The 'Environmental and Social Safeguard Policies' of IFC consist of the following operational procedures (OP):

- OP 4.01 Environmental Assessment
- OP 4.04 Natural Habitats
- OP 4.09 Pest Management
- OP 4.10 Indigenous People
- OP 4.11 Safeguarding Cultural Property
- OP 4.12 Involuntary Resettlement
- OP 4.36 Forestry
- OP 4.37 Safety of Dams
- OP 7.50 Projects on International Waterway
- OP 7.60 Projects in Disputed Areas.

In addition, bilateral donors have their specific guidelines for incorporation of environmental and social concerns into project planning and implementation. This EIA has paid particular attention to safeguards of the World Bank.

3.0 AREA PROFILE, ARUA DISTRICT

3.1 The Location and Size

Arua district is located in the northwestern part of Uganda. It lies between latitudes 2°30' and 3°50'N and longitudes 30°30'E and 31°30'E. Bordered by two sovereign States; The Republic of Sudan in the north, Democratic Republic of Congo in the west, whilst the districts of Nebbi, Moyo, and Gulu lie in the south, east and south east respectively. The district covers about 3.3% of the total land area of Uganda. About 0.3% of the area is under aquatic ecosystem, the rest being terrestrial ecosystem covering different land uses but agriculture predominates.

3.1.1 Topography

Arua district is comprised largely by rolling plains, with diverse altitudinal range from the rift valley bottom of 600 to 1300 metres above sea level along the mountain ranges of Kei. The oldest Pre-Cambrian metamorphic rocks underlie the area. Three topographical zones are recognizable;

The Madi plateau covers the eastern part of the district, within the counties of Aringa, Terego (the project area) and Madi-Okollo, western highland plateau (1200-1330m) within Vura and Aiiyu sub-counties, and the Rift valley escarpments in the southern part. The vast area of Arua is bisected by valley bottoms and drained into the Albert Nile.

3.1.2 Climate

The rainfall in the region decreases from the moist sub-humid hilly region in the west to the dry sub-humid flat region in the east. The dividing line more or less corresponds to the north-south Rift Valley escarpment. The mean annual rainfall varies from more than 1500 mm in the west to less than 1000 mm in the east. The seasonal rainfall has one peak between April – November. The long term variation is cyclic with persistent wet years followed by extended drought years.

The climate of Arua district is typical tropical in nature, with bi-modal rainfall pattern. August to November and April –June being wet months and the rest of the months

remain dry. Mean annual rainfall ranges from 1000 mm to 1500 mm. With December to March having high temperatures whilst August and September receive large amounts of rainfall. Mean monthly evaporation ranges between 1300mm to 1800mm. The climate radically influences the habitats that in turn influences distribution patterns of biodiversity and human activities in the district. Climatic and hydrological analysis of the project has been comprehensively done by the M&E Consulting Engineers (M&E Associates, 1998 pp.21-29) and adapted by this study.

3.1.3 Hydrology

The specific runoff in the region decreases from west to east, corresponding to the rainfall pattern. The headwaters of most of the major rivers in the region originates from the boundary with the Democratic Republic of Congo and drain into the Albert Nile basin in the east. At the hilly headwaters in the west, the stream network is dense and stream gradient steep but after the Rift Valley escarpment, the rivers become sluggish before joining the Albert Nile through extensive swamps.

The major rivers are Ora (with major tributaries of Nyagak and Nyarwodo), Ala, Enyau/Oru, Kochi, Amua and Esia.

Stream flow data from the Directorate of Water Development for 10 gauged catchments on these rivers has been analysed. The reliability of the river flow records have been assessed in detail: through checking the catchment areas, double mass plot and inspection of the rating curves. In general the quality of the data is satisfactory.

The lowest flow for River Enyau was estimated at $0.127\text{m}^3/\text{s}$ at the end to the dry season in February. The maximum flow was estimated at $2.1 - 2.3\text{m}^3/\text{s}$. The average yearly flow was estimated at $0.65 - 0.72\text{m}^3/\text{s}$.

For assessment of the hydropower potential, the reliability of the river flows and concentrated falls on the reaches of the rivers have been investigated.

The assessment of the reliable flows have been based on historical hydrological data from Directorate of Water Development (DWD) and extrapolation of the potential hydropower sites. Concentrated falls and hence potential hydropower sites on the rivers have been identified based on hypsometric curves of the major rivers, plotted

from 1:50,000 topographic maps of the region. The estimated catchment areas draining to the proposed hydropower sites have been measured. For the overall assessment of the hydropower potential, run-of-river schemes (without reservoir storage) have been considered as these are low cost and environment friendly ways to generate power. Maximum potential (with 1000% regulated flow) have been calculated to reflect the total potential of the sites. The M&E Associates , Consulting Engineers did a comprehensive study on this and have ably analysed hydrological conditions of the project area which this study adapts.

3.1.4 Biodiversity

Biodiversity, the total variety of life form is the primer for sustainable development of Uganda and Arua district in particular. Due to the diverse altitudinal ranges and tropical climate in the region, there is a modest level of diversity. The district is covered by post cultivation vegetation, grassland-woodland savannahs and aquatic ecosystems. These are dominated by fire climax plant communities *Combretum-Terminalia-Loudetia*, *Combretum-Acacia-Hyparrhenia* (Langdale-Brown *et al* 1964) However, the natural habitats have been heavily influenced by Man due to high population pressures and associated biodiversity degradation activities such as poor agricultural technologies, frequent illegal fires, deforestation, over-fishing etc. A complete list of biodiversity, in terms of Wildlife of Arua district has not yet been compiled although 175 species of birds, 180 species of butterflies have been recorded in the Mt Kei Forest Reserve which is fairly dry *Combretum-Terminalia-Loudetia* and *Butyrospermum* savannah ecosystem. Some of the Globally important and rare wildlife species have been lost from the district; e.g. White Rhino *Cerotherium simum*, Elephants *Loxondonta africana Africana*. Presently, relic populations of small-medium sized mammals such Duikers, Bushbucks, *Crocidura somalica* are found in the district. However, Arua district is still very important for the conservation of the endangered Black-Crowned Crane *Balearica pavonina* and Grey Crowned Crane *B. regulorum*, 15 biome restricted Sudan-Guinean bird species, 30 uncommon plant species e.g. *Aeschynomene schimperii*, *Combretum racemosum* and *Morinda titanopylla* (Devenpot & Howard 1996; Byaruhanga *et al* 2001). It is a major challenge for the district to conserve the few remaining natural resources amidst the growing demands without further compromising the integrity of natural resources.

3.2 Socio-economic baseline for Arua District

This section discusses the socio-economic baseline of Arua district i.e. health, education, agriculture, water and environmental sanitation, population etc.

3.2.1 Population size, growth and structure

According to different censuses, the population of Arua District increased more than two folds in 32 years from 264,800 in 1969 to 637,941 in 1991 implying an annual growth rate of 2.5% per annum. The growth rate between 1980 and 1991 was 2.73% per annum. Taking into account the current demographic trend including the effect of HIV/AIDS, the district's population is projected to be 817,900 by mid 1999. At the current population growth rate the population is expected to double itself in 24 years.

In terms of population structure, women are proportionately higher than men. For every 100 women, there are 93 men. This however, is typical of sex composition of many districts and countries. A very high proportion of the district's population is in the young age group. 23% of the total population is children aged between 0-5 years; 22% are aged between 6-13 years (primary school going age); 54% are aged between 0 – 17 years. Secondary school population (14 – 17 years) constitute 9% of the total population. The productive age group (15 – 64 years) is 71% of the total population, meaning that the district can provide the labour force required by the project. For only 2.5% are aged 65 years and above. In Katrini sub-county, where the project will be located has a population of 23,552 (population and Housing Census of 1991). Of this 8,402 fall into the category of productive age group (that 15 – 34 years). This means the project can get sufficient labour force within the project area especially for unskilled and semi-skilled labour requirements.

Table 1 Demographic features in Nebbi and Arua Districts

Population				Population	Population Growth (% p.a.)	Literacy Rate (Age 10 plus)	
Census Year	Male ('000)	Female ('000)	Total ('000)	Density (inh./km ²)		1991	(%)
Nebbi							
1969	98.7	105.4	204.1	73.4	1.3	Male	66.6
1980	111.6	121.4	233.0	83.8	2.8	Female	29.0
1991	152.1	164.8	316.9	114.0		Average	46.8
Arua							
1969	178.7	190.9	369.6	48.7	2.4	Male	65.4
1980	226.8	245.5	472.3	62.2	2.7	Female	28.0
1991	307.7	330.3	638.0	84.0		Average	45.7

Source: 1991 Population and Housing Census Report

3.2.2 Population density

The population distribution in Arua district is far from even. There is a relatively heavy concentration of people in the counties of Arua Municipality. Ayivu and Maracha. Koboko, Terego, (one of the counties in the project area) and Vura counties are moderately populated while Aringa and Madi Okollo counties are sparsely the sub counties of Aiiyu, Katrini and Yivu. Overall, the population density of Arua district, based on the 1999 mid year population projection is 108 persons per square kilometre (Arua Local Government. Arua District Development Plan, 2000/2001 – 2002/2003).

3.2.3 The Economy

Like many Ugandan districts, the economy of Arua is dependent on agriculture and it employs over 80% of the total population. Fertile soils and suitable climate combine to support the cultivation of a number of crops in most parts of the district. In the project area, crops such as cassava, sorghum, millet, sweet potatoes, groundnuts are commonly cultivated. Indeed, agriculture is mainly subsistence (79.9%) and takes place on small holdings of approximately two acres using mainly simple farming tools (hoes, pangas and barrowing sticks). Only 0.5% of the population are engaged in commercial agriculture. Cultivation of tobacco is reported in the sub-counties of Katrini, Aiiyu and Yivu. This is why, their area has been heavily deforested as trees have been cleared for tobacco curing.

Both food and cash crops are grown in Arua District. The major food crops include cassava, beans, groundnuts, simsim, millet and maize, all too common in the project area. Tobacco is the major cash crop and the main source of livelihood for the majority of the population in the district. It is grown mainly in the fertile highlands including the project area of Terego and Maracha. Cotton used to be grown in the lower and drier plains but due to marketing problems, it has been abandoned. The growing of coffee is also becoming common although not commonly cited in the project sub-counties. Nonetheless, there are renewed interest in the coffee production in many areas of the district now.

Other important economic activities in Arua district include formal employment which employs about 9% of the population. International Aid Agencies working with Sudanese refugees have done a lot in this area by providing employment to the

population. Petty trade and formal trade, employs 3.8% and 0.7% respectively. This includes cross-border trade with the D.R.C and Southern Sudan. Cottage industry employs 2.3%. The remaining proportion of the population depends on family support and other miscellaneous activities. A comprehensive cost-benefit analysis of the project has been done by the M&E Consulting Engineers and has been adapted by this study (M&E Associates, pp 57-60)

3.2.4 Health situation in Arua District

The health status of the people of Arua is poor compared to the rest of the county. A self-explanatory comparative analysis presented in Table 1 below attests to this.

Table 2 Arua District compared to National Health Status indicators

Indicator	Arua	Uganda National
IMR/1000 LB	100	97
CMR/1000 LB	240	203
MMR/100,000 LB	373	506
Annual growth rate %	2.7	2.5
Wasting %	5	5
Stunting %	47	38
Fertility rate	6.7	7.1
ANC attendance %	90	
Assisted deliveries 4%	23	40
Fully immunized infants %	28	47
Safe water coverage %	54	25.8
Latrine coverage %	52	41
Male literacy rates %	65	65
Female literacy rates %	28	45.7

Source: Arua District Local Government.
Arua District Development Plan 2000/2001 – 2002/2003

Though the district has some unique problems the common causes of morbidity and mortality are basically the same as in the rest of the country. Malaria, ARI, diarrhoea

constitute over 80% and two thirds of the morbidity and mortality respectively. In addition, Arua has unique problems. Plaque (shared with Nebbi), schistosomiasis particularly along the Nile (prevalence of 56% among school children), trypanosomiasis, onchocerciasis and Burkett's lymphoma in which Kuluva Hospital is a collaborative research unit.

Table 3 . Common causes of morbidity and mortality in Arua District

Diseases	Percentage
Malaria	37.0
ARI	18.0
Intestinal worms	12.0
Trauma	10.0
Diarrhoeal Diseases	7.0
Skin Infection	5.0
Eye Diseases	4.0
Dental Diseases	4.0
Ear Infections	2.0
Complications of Pregnancy	1.0

Source: Arua Hospital 2001

The district is also prone to outbreaks of cerebrospinal meningitis, cholera, dysentery, rabies, measles and other immunizable diseases. There have however been no outbreaks of CBM in the recent past.

Arua District Health System (DHS) comprises both the traditional and modern arms. Traditional Birth Attendants (TBA's) herbalists and traditional healers are the most prominent within the traditional arm. Of these TBA's (of whom 611 are trained) are the ones closest to formal health sector. The modern arm on the other hand comprises health units (government, private not for profit and private for profit), private practitioners, and Community Resource Persons (CRPs).

The District Health System is supported by a number of international and local NGOs. These include international NGOs CUAMM, SCF, Medicus Mundi, MSF(F), World Vision, DED, and Oxfam. Local ones include Church of Uganda, Arua Diocese, Here

is life, and numerous CBOs. Others such as CARE and ACAV carry health related activities on nutrition and water respectively.

The district has a total of 67 health units four of which (AMC, IIRO, Ullepi and Yoyo) are currently not functional for a mix of security, personnel and sponsorship reasons. Of these 27 are HC IIs, 355 HC IIIs, 1 HC IV and 4 hospitals (1 regional, 1 district and 2 NGO with a combined bed capacity of close to 900). Three Peripheral Health Units (PHUs) Koboko, Omugo and Rhino Camp are currently being upgraded to HC IV.

In Terego and Maracha counties, health services are still poor for example in Katrinin sub-county, in Terego county, there is only one health centre, that is Chillio health centre, which is also the nearest to the project location, and one NGO dispensary Aripea. Chillio Health Centre (Grade III) is 3 kilometres from the Olewa site.

On the overall, it is presumed that over 60% of the population live within 5 kilometres of a health unit.

3.2.5 Education

Illiteracy and low educational attainment is still a problem in the district and this has adversely affected success of many development programs. This means the project can rely mainly on unskilled and semi-skilled labour force from the district, while most skilled labourers may have to be got from outside the project area..

As shown in Table 4 below, out of those who can read and write, very few have attained education levels higher than primary seven. Moreover as the same table shows, only 4% and 2% of men and women respectively have attained senior six level.

Table 4 Gender disaggregated educational attainment of population 6 years + old

Educational Attainment	Male	Female	Total
P. 1 – P. 3 (%)	32	46	38
P. 4 – P. 7	44	42	44
S.1 – S. 4 (%)	19	9	15
S.5 – S.6 (%)	4	2	3
Post-secondary	1	(0.5)	0.8
Literate population aged 10 years + (%)	77	46	61

Source: Data derived from 2000 Socio-economic Conditions in Arua District

The response to the Universal Primary Education (UPE) is good in Arua district as well. Enrolment rates have increased from 54% before the introduction of the UPE to 100% of the estimated district population of aged between 6 – 13 years (primary school going age).

3.2.6 Agriculture

Agriculture is the most important economic activity in Arua District. 96% of the households depend on subsistence farming and their principal sources of livelihood. The sector provides employment to over 80% of the active rural population.

Most farms, that lie in Katrini and Aivvu sub-counties, are small in size and production is mainly for subsistence, plus very few modest excess for sale. Most farm sizes are below 1 hectare. Over 70% of land holdings are less than 1 hectare (Deloitte and Touche Consulting Group, 1996). Scarcity of agricultural land was reported in the project area with many people leasing land for tobacco growing from those who have more than they need.

Like in many parts of Uganda, land in rural Arua is mainly communally owned and governed by the customary system of tenureship. Under this tenure arrangement, land ownership is vested in the lineage and is allocated by a father to his sons, who in turn, assign it to their wives and children for cultivation. It is also the head of the household (land owner). Who has the responsibility to rent or sell out portion of such land in case of need; though this is done after consultation with and the consent of the large members of the lineage is obtained.

Table 5 . Land use in Arua District

Land use	Area (Ha)	% coverage
Arable land	681,575	87.0
Forests	67,740	08.7
Wet-lands	21,800	02.8
Mountains	5,700	0.7
Game reserve	4,500	0.6
Open water	1,700	0.2
Total	7830.015	100

Source: Arua District Development Plan 2000/01 – 2002/03 Vol. 1

Farming systems in the district are mainly based on a few traditional cash crops – tobacco, coffee in some areas, cotton in the past and a wide range of food and oil crops.

Production is done using rudimentary tools (hoes, sticks, etc) and family labour is the single most important source of agricultural labour.

Both food and cash crops grown include cassava, beans, groundnuts, simsim, matoke, millet and maize. Apart from simsim and matoke, all the other food crops are grown around the Olewa site.

Tobacco is the major cash crop and is the main source of livelihoods for the majority of the population in the district. It is grown mainly in the fertile highlands including where the Olewa site is located.

Table 6 . Tobacco production in Uganda and Arua Districts (Tonnes) 1984-93

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Uganda	1,969	1,613	949	1,214	2,639	3,456	3,322	5,140	6,686	5,183
Arua	1,187	1,094	760	845	1,393	2,730	2,813	3,018	3,238	3,474
% share in Arua	60.2	67.8	80	69.6	52.7	78.9	84.6	58.7	48.2	67.0

Source: *Arua District Development Plan 2000/01 – 2002/03 Vol. I: Policy Framework*

Although livestock is not a dominant activity in Arua, its significance can not be underestimated. Animals play major roles in the district’s socio-economic activities. Animals kept include cattle, goats, sheep, pigs, rabbit and poultry. The district has about 117,000 herds of cattle. The cattle are mainly of the local zebu type.

Fish production constitutes one of the important activities in the district. Most of the fish produced in Arua district is mainly for domestic consumption and for sale in the local markets within the area. However, no fishing activities were reported in the River Enyau, at least not near the Olewa Falls. Fish production is categorised into two i.e. Artisanal fisheries and Agriculture or fish farming.

Agro processing small scale industries have largely remained unexploited due to various reasons. One major factor is lack of electricity power. The Olewa Hydropower Scheme once developed will make significant contribution in this area.

3.2.7 Infrastructure

Road infrastructure in Arua district is rather poor. The road network falls under four categories namely, trunk roads (558 km), feeder roads (1178 km), community roads (550 km) and urban roads (tarmac, 6.4 km and murrum, 34.2 km). All the roads in the sub-counties of Katrini, Aivu and Yivu are murrum surface. Some fall under feeder roads while others fall under community road. The road surface from Wandi to the Aivu sub-county headquarters is rather well maintained. However, the road from the sub-county offices to Burua Church requires re-grading while from the church to the Olewa site there exists only a footpath which will require widening.

4.0. PROJECT DESCRIPTION

This chapter describes the Olewa hydropower project as described in the feasibility study report by M&E Engineering Consultants.

The West Nile Hydropower Project will develop the hydropower resources in the West Nile region by installing two run of river electric generation facilities on two rivers and operate the West Nile electric distribution system with focus on the initially three urban centres in the region namely Arua, Nebbi, and Paidha . The main components of the WNES project are as follows:

- The sale or lease of the UEB's generation and distribution assets in Arua and Nebbi Districts;
- The construction of ca. 80 km of sub-transmission line between Nebbi and Arua built by the Government of Uganda (GoU) and to be leased to the licensee of the WNES project. 35 km of this line has already been constructed while the stretch to Nebbi from Bondo is to be constructed soon;
- The installation of two new efficient diesels (1 by 1.5 MW and 1 by 1.0 MW) as both base load during the construction of the hydro plants and later as peaking plant;
- The construction of a 5.1 MW hydro plant at the Nyagak site in Nebbi District during Phase I of the ERT, and, two or more years later, the construction of a 1.5 MW plant at Olewa site in Arua District, and
- The upgrading and extension of the existing distribution networks in Paidha and Nebbi townships and Arua municipality, the largest load centre in the West Nile region, and the connection of existing and new customers, including consumers who are currently operating their own generation facilities.

This description is of the proposed 1.5 MW plant at the Olewa site on River Enyau in Arua District.

This phase of the Olewa project, that is Phase I, for which an EI Study is undertaken, is the cheapest of all the options, as indicated in Table 7 below, and other components can be added at a later date to build up to the full potential of the river. Another EI Study may be required as a reservoir will be created in the next phases if at all will be developed. Otherwise the present proposal is as follows:

(i) First Project, for which this study is concerned: Olewa run-of-the river scheme with installed capacity of 1.4MW. Output will be 0.35MW (raised by daily regulation of 0.7MW) and

1.4MW for 75% of the year. The maximum abstraction flow will be 2.8m³/s, with a head of 60m.

Table 7 Power Potential on River Enyau with Reservoir Options

Alternative	Storage Capacity (mm ³)			Flow at 90% Reliability (m ³ /s)		Power at 90% Reliability (MW)	
	Olewa	Oru	Mvepi	Olewa	Mvepi	Olewa	Mvepi
Run-of-River	-	-	-	0.63	1.10	0.35	0.6
Scheme I	27	-	-	2.8	3.1	1.4	1.5
Scheme II	-	12.4	-	0.63	2.73	0.35	1.3
Scheme III	27	12.4	-	2.8	4.27	1.35	2.0
Scheme IV	27	12.4	8.4	2.8	4.85	1.35	2.3

4.1 The Project Outline

The project outline is as follows:

- (i) Construct a flow abstraction weir about 60m elevation above Olewa falls.
- (ii) Construction settling chamber adjacent to the weir structure.
- (iii) Provide a low-pressure water conveyance system from the weir to a location that results in the shortest length of penstock.
- (iv) Provide 2 No. penstocks to the powerhouse.
- (v) Construct a powerhouse complete with all the required plant and equipment.
- (vi) Provide a transmission line from the power site to Arua Town.
- (vii) Provide the plant and equipment to connect up into the existing distribution system.

4.2 Flow Abstraction Weir and Stilling Basin

This is a mass concrete structure. The crest of the weir is set at a level varying between 0.5m to 3.5m above the bed of the river. The width varies from 0.5m to 2.3m, and the weir is 70m long, this will be within the existing flood plain that gets regularly flooded.

A concrete weir has been chosen because it allows the floodwaters to pass over, as well as any large objects washed down in the floods. The weir section has got both deep and shallow water sections that will facilitate this. The existing topography at the site has resulted in these advantages.

2 No DN 1000 steel pipes, regulated by butterfly valves abstract the flow. These lead the supply to a stilling basin 12m long, 7 m wide, and 3-4m deep with two compartments. This facilitates the settlement and the removal of sand and silt. The flow velocity drops within the basin and allows sand to settle. Valved desludging pipes allow the basin to be desludged under water pressure. If manual desludging is necessary, this will be possible without shutting down the power plant as the basin has two chambers that can be independently desludged.

The desludging within the river will be done manually during the low flow season when workmen can get onto the riverbed and carry out this activity.

This weir is about 100m away from the existing road bridge. This bridge deck is presently set at 4.3m above the level of the weir. This will be more than 3m above the 1 in 50 years flood level over the weir. A provisional sum has however been included in the project to enable the local government to raise the bridge. The road and the bridge belong to the local government, and it is administratively easier for local government to do this work than the developer. This avoids a conflict of responsibility and standards.

4.2.1 Flow Transmission

These works are designed to carry the flow from the abstraction weir to the generating station. To limit costs, the designs have adopted both a low pressure and high-pressure conveyance system.

The topographical terrain in the region results in considerable distance between the point of abstraction, and the powerhouse to be able to gain adequate head (e.g. 60m) to generate reasonable levels of power. The river gradients, even at the selected high gradient areas, are very gentle. The design has therefore adopted a low-pressure system to carry the flow through a gentle gradient up to the convenient location, before putting the water into a high-pressure pipe (penstock) to deliver flow to the powerhouse.

The low-pressure system may consist of any of the following;

- (i) open earth (un-lined) channel
- (ii) open concrete lined channel
- (iii) open stone pitched channel
- (iv) low pressure up PVC pipes.

The lowest capital cost is in the open earth channel, but this needs constant maintenance to keep clear. The highest cost is in the low-pressure pipe, but this has the advantage of virtually no maintenance. The lined channels provide the conditions between these two extreme positions.

The high-pressure system will be a penstock of adequate strength to withstand the extreme static pressure and the shock (surge) pressures. This will be either steel or polyethylene. Steel is the more expensive option, but has the advantage that it does not have to be buried. The polyethylene is cheaper but needs to be buried.

4.3 Topographic Conditions

The river has a very gentle slope below the Olewa falls, and considerable distances would have to be covered to gain a small additional head. Abstraction beyond the bridge at Katrini would be counter production. A major tributary (R. Oluffe) joins R. Enyau at that location, and this flow would be lost. The available head between the bridge and Olewa falls is 60m.

4.3.1 Flow Regulation

The average annual variation of river flow at the site is given in the graph in Figure Marked in that drawing is the flow used to size the low pressure conveyance channel, penstock, and the power generation equipment. It can be seen that for the month of January, February and March, the base power output could be 30% of what the plant is capable of generating. This critical period is usually smoothed out by seasonal impounded regulation storage i.e. a dam. This however is beyond the resources of this phase of the project. This can however be added to the system at any time in the future, with few alterations to the existing system.

The hourly regulation regime could be by flow conservation through reduced discharges and lower power generation in the low demand times (e.g. midnight to morning), and using the water conserved for higher generation in the day time. This is the method adopted for Kuluva hospital power supply. The institutional nature of Kuluva hospital however has the advantage that low power demand times can be precisely determined, which is not the case in this scheme. This regulation needs limited storage. Usually 1-2 days of storage is adequate. This would amount to 60,000 – 120,000 m³ at this site. In this scheme, the storage will be as follows:

- (i) behind the abstraction weir (approx. 120,000 m³ is possible)
- (ii) within the flow channel (approx. 10,000 m³ is possible)

4.4 Low Pressure Conveyance System

The water will be led from the abstraction weir along a gentle fall up to the penstock site. The gradient to be followed is 0.1%. The various options for the conveyance system are discussed below.

4.4.1 Open Channel

This is the normal way to convey the water at the lowest cost. Within this option are sub-options of having an un-lined channel, and a concrete lined channel. Concrete lining, though resulting in considerable increase in the cost of the works, results in low maintenance costs as well as a superior carrying capacity.

To obtain a reasonably straight alignment that would result in as short a length as possible, the system would have to be a combination of channels and inverted siphons (pipes). The siphons would be necessary to cross valleys along the route.

A chief drawback of the channel is one of safety. Parts of it will be crossing through farmland and populated areas. There is a risk of people falling into the channel, and inconvenience to people crossing to locations on either side of the channel. To overcome this problem, the design has adopted a wide channel with a low depth of water. This also has the advantage of minimising the cost of rock excavation. There is a higher than average level of rock outcrops along the channel alignment.

For an earth trapezoidal channel with base width to water depth ration of 4 to 1, and channel side slopes of 1:2, the requirements to convey a flow of 2.5-3 m³/s will be as follows:

Lined channel

Base width	-	2.5m
Water depth	-	0.62m
Top width	-	5.9m

Earth channel

Base width	-	2.7m
Water depth	-	0.67m
Top width	-	6.6m

The cost of a lined channel is about US\$ 160 per running meter, while the cost of an unlined channel is US\$70 per running meter. The choice of channel is incumbent upon the developer based on this price comparisons.

With an additional depth of 0.3m, the channel will be adequate for the full site development. Some saving can be realised from paving the lower sections of the channel in the initial phase. It is considered necessary to construct the full capacity channel, either fully or partly lined, in the initial phase investment for the following reasons.

- (i) the volume within the channel for the full length is intended to contribute to the storage requirements for hourly flow regulation in the lowest flow periods.
- (ii) The investment is not large enough to realise major savings I costs from the postponement of excavation.

The savings in operation and maintenance costs for the lined or partly lined channel are well worth the investment, and this is proposed for construction.

4.4.2 Piped System

In this system, a low-pressure pipe is used to convey the supply from the abstraction weir to the penstock. The maximum pressure drop does not exceed 10m. A drainage grade UPVC pipe or P.E pipe would be adequate. A low-grade steel pipe, suitable protected from corrosion would be acceptable. The contractor may supply any pipe system as long as it is suitably protected. To ensure that the surge pressures from the penstock do not cross to this pipe, an open chamber is provided at the end of this pipe. This chamber also serves as an over flow structure to spill excessive flow back to the river. To facilitate this function, it is designed as an overflow structure, and provided with an earth outfall channel back to the river.

The greatest advantage of is method is that it is environmentally friendly. The pipes are buried and do not interfere with land use. Its greatest disadvantage is the increased cost, which is more than 50% over the cost of a lined channel.

4.5 Proposal

The M&E Consulting Engineers think that the cost of the piped system is too high even for the safety level given. The concrete lined open channel is proposed where possible. To mitigate the dangers to people, a low fence (1.0m high) of barbed wire will be run along both sides of the channel, and footbridges provided at the established footpaths.

4.5.1 Penstock Size

The power outputs required and the pressure rating of the pipe have set the upper size of the penstock. The pipe materials considered for the penstock are steel and polyethylene (PE). These are available in the range of sizes required for this project.

The maximum power generation capacities for various penstock sizes are given in the table below. This assumes a pressure rating for the penstock of PN 25, and designing the penstock to accommodate full surge pressure.

Table 8 . Penstock

Size (mm)	Flow (m ³ /s)	Max Power (MP)	Minimum Power (MW)	
			Continuous	Daily Regulation
600	0.78	0.31	0.3	0.8
700	1.0	0.44	0.4	0.8
800	1.4	0.61	0.4	0.8
900	1.8	0.77	0.4	0.8
1000	2.2	0.99	0.4	0.8
1100	2.7	1.21	0.4	0.8
1200	3.1	1.43	0.4	0.8
1400	4.2	1.98	0.4	0.8

The minimum size of a single penstock to meet the present demand for power would be a DN 1200m pipe. The ultimate capacity at the site could be realised by the installation of a second penstock, at the time of the construction of a flow regulation dam for this power generation site.

4.6 Power House

The powerhouse area consists of the generation room, offices, an open switchyard, and vehicle parking facilities. The powerhouse has a high clearance (6m) to enable the equipment to be moved around by a crane, and to allow vehicles to back-up into the building. The floor area of the powerhouse and offices is 217m² and incorporates the generating area, workshop, stores, and offices.

An outdoor switchyard is provided, and is paved in concrete. The whole site is securely fenced and provided with adequate drainage and vehicle parking.

The powerhouse is set 1.2m above the highest flood marks, but the floor is sunk to 0.5m above the high flood level. The switchyard is set more than 2m above the maximum flood level. The present high flood level, at a river width of 60m, and the prevailing gradients at the site result in a peak discharge in the river of 226 cubic metres per second. This is much higher than the one in 50 year flood of 187 cubic metres per second.

4.7 Site Access

There is no existing access road to the proposed power site, this will be provided under the project. The total length of new road is 1 km. The existing road from Owafa to the site will however need to be graded and the drains opened up. The total length of road to be rehabilitated is 4 km. Only a low-grade gravel road will be provided to afford access to regular off road vehicles, and the occasional delivery trucks.

The flow abstraction weir is right next to the road and does not need any special access. Virtually no vehicular access is necessary to this site.

Selected pages of a detailed report analysing the predetermined option of the Olewa project which is the basis of this EIS study has been provided as an annex in this report.

5.0 EXISTING ENVIRONMENTAL BASELINE

This chapter describes the baseline condition at the project area based on the district level descriptions in Chapter 3.0 and additional details obtained from literature reviews, discussions, and previous studies. The chapter provides information on the physical, biological and socio-economic environment, to facilitate the evaluation of potential impacts in chapter 6.0. Subsequently, the descriptions are more focused on the project area and put emphasis on resources most likely to be affected by the proposed development.

5.1 Physical Environment

5.1.1 Climate and Weather Pattern

The climate of Arua district is typical tropical in nature, with bi-modal rainfall pattern. Heavy rains are experienced between August to September and light rains from April – November. Mean monthly evaporation ranges between 1300mm to 1800mm. With December to March having high temperatures whilst August and September receive large amounts of rainfall. The climate radically influences the habitats that in turn influences distribution patterns of biodiversity and human activities in the district.

5.1.2 Geomorphology, geology and soils

Arua lies within the extreme limits of the western rift valley plains referred to as the Madi plains. Inselburgs and tours occasionally interrupt the vast plain. And the inselburgs are the result of wind erosion, combined actions of wind and water erosions. Towards the Nile, areas of faulting are still prominent. A series of scarps in the west separate rift valley plain from the eastern Madi plain.

Vertisols, a nutrient rich soil dominate the swamps, river basins and seasonally inundated areas of Arua district (Environment Report, 1998). This soils have characteristically high content of swelling and shrinking clay lattice (2:1), which under dry conditions become very hard and difficult to work. Similarly they are difficult to work under wet conditions because they expand and become excessively moist and sticky.

Plate 1: The Deputy Speaker Arua District Mrs. Christine Aciferu with members of the Local Community at the Olewa site, ready to attend a community consultation meeting

Plate 2: The ecology of the project area at the Olewa site. Much of the shrubs will be cleared during construction work.

5.1.3 Hydrology

River Enyau falls within the Albert Nile catchment zone. The catchment area of this river covers an estimated area of 749 km², originating from eastern Congo highlands draining into the Albert Nile. The hydrological characteristics of 1955-1978 indicate that past mean annual flow/runoff was 6.908 m³/s and minimum monthly recorded flow was 0.323 m³/s. Clearly there is wide difference in mean, minimum and maximum flow of this river, a reflection on a variable amounts of annual rainfall patterns that range between 1000-1500mm annually. However, the evapo-transpiration in the Arua district in general, can be very high 1600 – 1750 mm with a net loss of water. The profile of River Enyau is fairly gentle 1000 m to 1050 masl. The large human populations of Arua district, related forest degradation and agricultural activities within the catchment areas negatively impact the hydrology.

Seismology

Arua district is within the seismic zones of the world. Minor tremors have been recorded during the last decade.

5.2 Vegetation

The project site lies within an interface of four major ecological zones (Langdale-Brown *et al.* 1964) the *imperata-panicum-hyperrhenia* post cultivation community, *combretum-acacia-hyparrhenia* and *butyrospermum-daniellia-hyperrhenia* savannah ecosystem. At present heavily disturbed grassland savannah-cultivation communities dominate the proposed site at Olewa. But there are a few trees of *Acacia hockii*, *Terminalia mollis*, *Ficus*, *Albizia* and *Trichilia* spp. However, the river course is more natural and dominated by *Pennisetum purpureum* (Elephant grass). The overall species recorded is given in Appendix 1.

5.3 Wildlife

The project area is under heavy human influence and hence there are no major wildlife species of ecological importance.

Mammals

The proposed project area is mainly a cultivated area with the natural vegetation only lining the riverbank. The most abundant mammals found in the area therefore were the common small mammals: rats, squirrels, shrews and bats that are widespread and common in the country. Larger mammals if present are rare and were not met during the surveys.

Birds

During the surveys we recorded a few bird species (see appendix 3). With the exception of the Black-crowned Crane *Balearica regulorum* that is confined to the northern region and is rare and threatened, the majority of the species recorded in the project area are common and widely distributed and occur in scrubland and open cultivation. The Black-crowned Crane is a wetland species but it is unlikely that it will be affected by the disturbance. Migratory species like swallows were common and are likely to be positively affected by the project since patches would be made available via transmission lines.

Fish

The Olewa River is reported to contain mudfish and some species of tilapia. Children on a haphazard basis catch mudfish mainly during the dry season. The Olewa River at the project site is a narrow, fast flowing river and fishing is not an activity undertaken by villagers. No reports of fish migration or other species were reported in interviews.

Reptiles

Villagers reported few poisonous snakes in the area. Some mentioned the presence of the black water cobra *Naja melanoleuca* and the Nile Monitor *Naranus niloticus*. These reptiles are common and widely spread and unlikely to be affected by the disturbance.

5.4 Socio-economic Baseline

5.4.1 Human Environment

The West Nile Region, which is separated from the rest of Uganda by the River Nile only became incorporated into the present day Uganda in 1914, having been part of the Lado enclave, administered from the Belgian Congo Free State until 1910 and subsequently from Sudan for a few years. Until recently, it was comprised of Nebbi, Arua and Moyo districts, but now it has been subdivided into smaller districts which are Arua, Nebbi, Yumbe, Moyo and Adjumani. The Olewa mini-hydropower project is in Arua district which is inhabited by four major ethnic groups namely, the Lugbara, Kakwa, Made and Alur.

5.4.2 Water and Environmental Sanitation

The water supply and sanitation situation in Arua district is still unsatisfactory though slight improvements have been recorded recently. According to the Arua District Socio-economic Survey report (2000), the overall safe water coverage stands at 57%. The analysis by rural urban distribution revealed that 97% of the urban and 54% of the rural residents have access to safe water in Arua district. In respect to sanitation, only 51% of the households in the district have safe toilet facilities. 51% of the rural residents use unsafe toilet facilities while for urban residents were 8%. Institutions, particularly primary schools where the massive increase in enrolment under UPE has over whelmed the capacity of the schools to provide adequate toilet facilities. Therefore, the most prevalent diseases afflicting the population have direct link with poor water supply and environmental sanitation.

For example the recurring cholera epidemic in the district is but much to do with drinking water from unsafe sources and poor sanitation. With respect to water supply, majority of the population in the district relies on the open water sources (springs, well etc). All over the district there are still a number of unprotected springs. Through the WES program and DDP funded under the GoU – UNICEF County program and UNCDF respectively, funds have been made available to the district currently for spring protection.

In the project area water and environmental sanitation is not any better. For example people in the project area drink water from River Enyau despite pollution with human faeces and animal wastes. There are only 24 boreholes in the whole of Katrini sub-county serving a population of 23,552 people. Poor latrine coverage is reported in the area. Out of the 121 springs, 58 are unprotected while 63 are protected.

5.4.3 The Economy

Like many Ugandan districts, the economy of Arua is dependent on agriculture and employs over 80% of the total population. Fertile soils and suitable climate combine to support the cultivation of a number of crops in most parts of the district. Agriculture is mainly subsistence (79.9%) and takes place on small holdings of approximately two acres using mainly simple farming tools (hoes, pangas and barrowing sticks). Only about 0.5% of the population are engaged in commercial agriculture. Family members constitute the single most important source of labour.

Both food and cash crops are grown. The major food crops include cassava, beans, groundnuts, simsim, millet and maize, all are a common sight in Terego county where Olewa falls are located. Tobacco is the major cash crops and is the main source of livelihood for the majority of the population in the district. It is grown mainly in the fertile highlands. Cotton used to be grown in the lower and drier plains but due to marketing problems due to mainly fall of world price, it has been abandoned by most farmers. However, cotton growing in Arua district is currently being encouraged as well as coffee growing especially in Terego county.

Other important economic activities in the district include formal employment, which employs about 9% of the labour force, petty and formal trade, which employees 3.8% and 0.7% respectively and cottage industry that employs 2.3%. Cross border trade with neighbouring DRC and South Sudan is practiced. The remaining proportion of the population depends on family support and other miscellaneous activities (Arua, DDP, 2000 – 2003).

Agriculture

Agriculture provides livelihood to more than 80% of the rural population in West Nile in general and Arua in particular.

The population census of 1991 indicate that between 80% ad 90% of the families in the region are involved mainly in crop and livestock production. It is also the most important economic activity as noted above. 96% of the households in Arua district depend on subsistence farming as their principal sources of livelihood. The sector provides employment to over 80% of the active rural population. This is clearly manifested during the site visit by the study team. From the junction to the Olewa falls, more than 99% land cover is under cultivation with mainly food crops.

Most farms are small in size and production is mainly for subsistence, plus very few modest excess for sale. Most farm size especially in Terego are below 1 ha. Over 70% of landholdings are less than 1 ha (Deloitte and Touche Consulting Group, 1996). People we talked to in Aivuvu and Katrini sub-counties indicated the scarcity of land as the main reason for small landholding. However, the situation is different in Madi Okollo county where population is relatively sparse, with holdings up to 5 ha.

- **Livestock**

Although livestock is not the dominant activity in Arua, its significance can not be under estimated. Animals play major roles in the district's socio-economic activities. Animals kept include cattle, goats, sheep, pigs, rabbits and poultry.

Most cattle owned are traditionally part of the mixed farming system, where they provide supplementary income (milk, meat and hides) and organic manure. There is a huge demand for cattle to replace the animals lost during the 1980 civil war.

The district has about 117,000 heads of cattle. The cattle are mainly of the local zebu type.

Those talked to in Aivuvu and Katrini subcounties indicate livestock keeping. In fact cattle is grazed along the Enyau River and that there is a salty food liked by cattle at the Olewa falls, the site for the weir and power house. Development of the site will therefore create a negative impact on livestock in the area.

- **Fisheries**

Fish production constitute one of the important activities in Arua district. Most of the fish produced in the district is mainly for domestic consumption and for sale in the local markets within Arua. Sudan and the DRC however, provide high potentials for the fish in Arua.

Fish production in the project area is categorised into two i.e. Artisanal fisheries and aquaculture or fish farming. The River Nile provides the bulk of the fish requirements of the district with 3 major landing sites at Fundo, Rhino camp and Pawor. The major species harvested include Tilapia, Nile perch, Mud fish and Lung fish.

5.4.4 Infrastructure

There is very poor communication system within and outside the project area (Katrini and Aiivu sub-counties). The common means of communication available are:

Road transport with vehicles, like motorcycles, cars, lorries and bicycles are also commonly used over long distance. While the road from Wandi to the Burua Catholic church is well maintained, there is need to widen the footpath to the site once construction work begins.

The district is maintaining feeder roads within the sub-counties while central government continues to maintain the truck roads. Under the District Development Plan (DDP), the sub-counties have undertaken the opening of the community roads. Postal services exist in the project area with a post office at Wandi trading centre. Network for mobile phones are rather poor in the area unless otherwise a booster is placed on the nearby hills to improve services.

6.0 ENVIRONMENTAL IMPACTS

The physical environment is going to be very little affected by the project. There will be some loss of agricultural land (estimated at 5 ha) that includes the land for the route of the canal, powerhouse site, and access road to the site. There are some impacts on the social environment. This includes restricted access to the river in the area of open canal, the social dislocation from the contractors activities etc. Mitigation methods have been included in the design and in the contract procedures.

Therefore the assessment of major impacts that may arise from the construction and operation of a hydropower plant at Olewa is based on:

- a review of available documentation;
- a visit to main constructions sites along R. Enyau;
- discussions with members of the community within and around project area; and
- discussions with various district authorities and NGOs.

6.1. Physical Environment

Hydroelectric projects include dams, reservoirs, canals, penstocks, powerhouses, transmission lines, and switchyards for the generation of electricity. The principal source of impacts in a hydroelectric project is the construction and operation of a dam and a reservoir. Large dam projects cause irreversible environmental changes over a wide geographic area and thus have the potential for significant impacts (World Bank 1991). While there are direct environmental impacts associated with the construction of the dam (e.g., dust, erosion, borrow and disposal problems), the greatest impacts result from the impoundment of water, inundation of land to form the reservoir, and loss of flooding as well as changes in flow patterns up-down stream. These effects have direct impacts on soils, vegetation, wildlife and wild lands, fisheries, climate and human populations in the area (World Bank 1991). However, the Olewa scheme does not fall under this category since it is a small dam thus impacts are likely to be minimal and mitigable.

The ecological impacts assessment of a development project on natural site in terms of species conservation, must involve the study of taxa whose survival is linked closely to

the existence of the natural habitats. Therefore for this study the taxa selected included plants, birds, mammals, fish and other animals.

6.1.1 Ecological Impacts

Using the framework provided for in the NEMA Environmental Impact Assessment Guidelines, potential negative and positive impacts were identified. Possible mitigation measures were also identified for the significant negative impacts. Where positive impacts exist, opportunities for enhancing them were also specified.

The major sources of environmental impacts of this project were assessed under the following: Surface runoff caused, landuse changes and management, hydrology, quarries/borrow pits, pollution, worker's camps, road safety

Negative Impacts

Surface runoff

During construction, project activities like vegetation clearance, creation of access routes & channels, dredging, quarrying are sources of unstable soils and compaction of soil due to movement of heavy machinery will increase the rate of surface runoff especially during torrential rains. These actions will cause soil erosion, gulling, siltation and increased sediment loads in watercourses especially within the lower catchment areas. Project activities may also cause change in local terrain.

6.1.2 Change of land use and management

The major causes in landuse will accrue from the following; the construction of concrete diversion weir, reservoirs, a fenced water channel (3 km long 2.5m wide and 0.6m deep), siphons at valley crossings, foot bridges along the channel, 1.2 km low pressure pipe, one surface penstock (1.2 m diameter and 1100m long), surface powerhouse, transmission lines, and switchyards for the generation of electricity. Part of the work will include road construction or realignments from Burua church to the powerhouse at the *Olewa falls*. Other quarries, administration building, worker's camps, storage of plant equipment would all lead to change in land use. During the process there is the destruction of the remaining vegetation lining the riverbank and changes in the scenic view. Agricultural land and some woodlots for fuel will be lost

permanently. However, ecological impact will be low given that this is largely farmland and fallow areas.

It is anticipated that if the project is constructed, there will be some influx of people seeking employment and other opportunities associated with the project. These people will need food, water, energy and shelter, which will increase the pressure on various riverine natural resources by direct harvesting of natural resources and changes in land-use (e.g. collection of wood fuel, increase in and intensification of subsistence cropping). Again, the impacts would still be LOW since common weedy shrubs of *Lantana camara*, *Vernonia*, *Acacia hockii* and *Albizia spp* line up the area BUT LONG TERM.

Vegetation

The vegetation in the project site is clearly described in Chapter 5. Areas of high ecological relevance or importance is scarce except some portions of the river course is more natural and dominated by *Pennisetum purpureum*, (Elephant grass, *Acacia hockii* and others. Eucalyptus woodlots belonging to families that are along access routes and project will be inundated, and destroyed. Apparently the woodlots form the basis of fuel-wood in the whole area. Other negative impacts due to vegetation clearance are likely to cause soil erosion. However, the negative impacts are easily mitigated. The opening up of an access road from Burua Catholic Church to the power house will cause loss to Eucalyptus woodlots, agriculture land and homesteads. Construction of transmission line from Wandu will cause temporary loss to agricultural land, crops and other properties. The impacts of these activities are likely to be low since this is a highly disturbed area.

Wildlife

Mammals

The proposed project area is mainly a cultivated area with the natural vegetation only lining the riverbank. The most abundant mammals found in the area therefore are the common small mammals rats, squirrels, shrews and bats that are widespread and common. However the local communities also reported the presence of Baboons, Colobus monkeys, cane rat and civet (see Appendix 2). The larger mammals such as

baboons are mobile and vermin species with a large home range and are unlikely to be affected by the disturbance.

Birds

During the surveys we recorded a few bird species (see appendix 3). With the exception of the Black-crowned Crane *Balearica regulorum* which is confined to the northern region and is rare and therefore threatened, majority of the species recorded in the project area are common and widely distributed and occur in scrubland and open cultivation. The Black-crowned Crane is a wetland species but it is unlikely that it will be affected by the disturbance. Migratory species like swallows were common and raptorial species were not common but are likely to be negatively affected by the project as result of the installations of power transmission lines. Globally, collisions and electrocutions of birds and mammals are under reported but can potential pose a serious problem. However, this problem is easily mitigated by re-designing power lines so that the high, thin, earth wire that birds often fly up into when they see the larger, lower wires, is no longer a hazard.

Fish

The Olewa River is reported to contain mudfish and some species of tilapia. Children on a haphazard basis catch mudfish mainly during the dry season. The Olewa River at the project site is a narrow, fast flowing river and fishing is not an activity undertaken by villagers. No reports of fish migration or other species were reported in interviews. Therefore, impacts on fish are expected to be low and insignificant due to project development.

Reptiles

Villagers reported few poisonous snakes in the area. Some mentioned the presence of the black water cobra *Naja melanoleuca* and the Nile Monitor *Naranus niloticus*. These reptiles are common and widely spread and unlikely to be affected by the disturbance.

Pollution

Dust is likely to be generated from quarrying, site clearance, and general construction activities. Other possible sources could be local modification of water quality as a result of suspended soil particles and other pollutants associated with construction and increased vehicular use. Servicing activities that come with wastes such as used oils, scrap material, dirty cloth and irresponsible dumping. There will be some noise

disturbance during project construction that will affect nearby communities and wildlife. The impact is considered LITTLE-MEDIUM negative during construction. Water quality changes will mostly have short-term duration during and soon after the construction phase.

Hydrology

The proposed project activities at R. Enyau will require the construction of a canal parallel to the river through which the river water will be diverted. The construction of the dam will result in reduced river flow along the 4-km stretch between the intake and the outlet. Depth, cross sectional area and velocity will be changed. The changes will be most pronounced in the dry season when the largest proportion of the river flow will be diverted into the overland channel. The exact amount of water in this section of the river will be dependent on the future hydrology of the river. Parts of the riverbed will become dry at least parts of the year, reducing potential available habitat for aquatic life. There will be a decrease in available aquatic habitats and aquatic life in the short river section under consideration. The magnitude of impacts will be SMALL NEGATIVE since there is low aquatic life existing.

Overland Channel

The diversion of overland channel from the dam runs 3 km overland. This channel would claim agricultural land, and form an artificial water body up to the point of the proposed water pipe that runs for another one kilometre. The creation of this channel is likely to increase the volume-surface ratio of water, nearly doubling the evaporation of the water body along the project site. The long-term impacts could be SEVERE depending on the yearly climatic changes.

Quarries/Borrow Pits

Extraction of materials from quarries/borrow pits and canals involves site clearance, movement of large construction materials from local sources to the construction site, results in significant quantities of wastes or eroded materials, and causes changes in topography or ground surface relief features. Mounds of excavated materials present visual obstruction and an unpleasant sight. Where the excavated pits are deep they present a risk to both animals and human beings.

Worker's Camps

The establishment of workers' camp requires on-site energy generation, accommodation, and portable water supply or sanitation facilities and therefore causes excessive demand on wood fuel and water for domestic use. The camp could easily be located near a marginal area or surface rupture that might be related to a fault.

Plate 3: The ecology of the Olewa site which will be cleared for the construction of the powerhouse

Plate 4: The ecology and settlement pattern near the Olewa site

6.1.2 Operational Phase

Hydrology

There will be diversion of some water from the main river channel at the weir towards the southern bank for about 4-km to the powerhouse before it joins the main river again. This action will result in reduced water level down stream along the river and could have impacts on flora, fauna and ground water level. The diversion channel banks and point where water gets out of the powerhouse could experience erosion. The diversion channel could also affect some farmland, could create problems of accessibility on the southern bank and loss of water due to increased evaporation rates. There could also be risk of man and his animals getting drowned.

The area behind the weir is expected to experience raised water levels but this will strictly be limited to the river channel, which is actually deep and wide.

Water quality

During operation the quality of the river water will be determined by the human activities upstream and the retention time. The water quality is likely to be affected by salinization, eutrophication from weeds and biomass decay, turbidity and pollution from loose soil being washed into the river during construction, agricultural and human activities.

Soil degradation and erosion

All areas disturbed during construction phase (roads, diversion channels, water pipes, storage areas, transmission lines, camps etc) are likely to experience some soil degradation (compaction, erosion). Increased economic activity in the area might also lead to changes in land use and increased erosion in the catchment areas. The sedimentation of the reservoirs and the reduction in life span will be affected.

The magnitude of impacts on soil degradation and erosion is expected to be **MEDIUM NEGATIVE** during the construction phase and **MINIMAL** during long-term operation. Soil degradation and erosion

Vegetation

No areas of high ecological value will be affected during construction or during operation of the power plant. There will be some permanent changes in the channel area. In addition to 0.4 km² proposed construction of access routes from Burua Catholic church to the powerhouse on the Olewa River, the area along the transmission line to Wandu will be affected. Some vegetation will be permanently lost and surrounding vegetation will experience changes in species composition towards more riparian species especially along the channel. Some of the nearby eucalyptus woodlots may be inundated. This will result in loss of valuable wood-fuel trees, the ecological roles played by these woodlots would be lost. Further vegetation clearance will lead to soil erosion and hence soil degradation, especially along the riverbanks. However, LOW impacts are anticipated. There is some concern that the water hyacinth, which is already found in parts of the district, will find its way into the reservoir at some time in the future. Although this is not a serious impact in itself it could cause problems in running the plant, by large biomass of the water hyacinth leaving against the walls of the dam thereby weakening it and leading to structural damage.

Aquatic ecosystem

The associated impacts on the hydrology will consequently impact on aquatic ecology. There will be changes in the natural flow regime in a short section of the river and water quality changes. These changes are likely to favour certain vectors e.g. *Schistosomiasis*, *Plasmodium* and *Onchocerciasis* that are already endemic public health concerns in the project area.

Fuel and oil spills from trucks and the transfer from trucks to storage facilities pose a potential hazard. Other petroleum products associated with equipment maintenance (e.g. hydraulic fluids, oil, solvents) and chemicals will be used in relatively small quantities. These fuels and chemicals, as a rule, are damaging to aquatic organisms. They can also pollute surface and underground water. The most important changes in water quality in terms of aquatic life are increased sediment load and pollution during the project construction phase. This will result in temporary avoidance by aquatic life of some areas just downstream of construction activities in the river. Macro and Micro organisms are likely to be particularly affected. Water quality impacts on aquatic life are likely to be small and short-term.

6.1.3 Positive Impacts

Creation of a small reservoir will favour some aquatic species (for instance invertebrates and fish) and water birds adapted to more slow flowing conditions rather than rapid flowing conditions that dominate the affected stretch of the river at present. Species that thrive in small water will be promoted and others such as Tilapia spp. may be introduced. These impacts are considered small but positive.

6.2 Socio-economic Impacts

- **Loss of agricultural land**

Based on the kind of works associated with the project, it appears that the total permanent land take will not be more than 10 ha. That is land required for the switchyard and powerhouse, settling tank at the weir site, access road from Burua Church to the power house, the construction of canal and land that will be periodically submerged especially during the rainy season. The area behind the weir is expected to experience raised water levels but this will strictly limited to the river channels which is actually deep and wide. Much of the land likely to be lost to the project belongs to the Local Council III Chairperson of Katrini Sub-County Mr. Yosia Adudoa, who owns about 5 hectares of land stretching from the last homestead to the falls right down to the proposed site of the powerhouse. However, no homestead will be displaced by flooding although the Bulodi bridge, 5 km upstream on the Arua – Koboko road could be affected regularly unless the bridge is raised by 2 metres during its reconstruction by the District Local Government.

Impacts due to construction activities

The impacts due to construction works will be many. Firstly, some limited visual impacts will be experienced as the landscape will be considerably altered by the diversion channel/pipe, site clearance, excavation, access road, workers' camp and other construction related activities. Disturbances to the residents near the sites and along access roads in form of noise/dust pollution plus traffic accidents and oil spillage will also occur.

Sources of construction materials have not yet been identified. It may be necessary to open quarries for aggregate and sand. Land for quarrying may have to be bought or leased. These will also cause similar impacts as construction work does. Besides if not filled quarries often cause problems to the local population including health, children/drun kard adults and animals drowning. However, impacts are expected to be low.

Access and Transmission Line

Although considered to be one of the a positive effects of the project, opening of access roads from Burua Church to the power house will cause loss of agricultural land to some families according to the feasibility study for the project the access road will be 1 km long and 4 m wide and will mainly cross cultivated gardens.

In addition, a transmission line to carry electricity to Wandi will be constructed. This is likely to affect human settlements thus causing temporary loss of agricultural land, crops and other properties such as houses.

Construction camps, workshops and stores

Though covering a relatively small area, workers' camps, workshop/yards and stores can, if not well managed, cause significant environmental damage for a considerably long time. The major causes are pollution due to all forms of wastes generated over time, increased fuel wood consumption, erosion and drainage effects, spillage of oils and fuel, land-take, dust, noise, construction of traffic routes, local inflationary pressure due to increased commodity demand. Social rifts and rivalry caused by cash-rich camp men will also be experienced. Insecurity, prostitution and increased incidence of sexually transmitted diseases including HIV/AIDS are also liked to be caused by these project activities.

Plate 5: Eucalyptus woodlot along the proposed access road to the Olewa site likely to be cleared. It can be minimized or avoided by re-routing of the road

Plate 6: The access road to the Olewa site will pass near this homestead and woodlot, unless aligned to pass away from the eucalyptus trees, some minimal impacts will be created.

6.2.2 Displacement of households/families

There will be no displacement of households/families due to project development. This is because most of the settlements in the project area are restricted to the hill tops and anticipated project activities which could otherwise cause the displacement of people are all based in or close to the river valley. However, widening of access roads from Burua church, perhaps during the laying of the channel and construction of power lines from Wandu to the powerhouse could affect a few building and trees. Nonetheless, this can be avoided by re-routing the original course to minimise damage to people's property. If possible the channel/canal should also be restricted in the valley in order to minimise impacts on cultivated land.

- **Effects on aesthetic and scenic qualities**

All the structures that will be built plus the power lines will change pre-existing and scenic qualities of the project area and potential for certain recreational uses. But most of the structures will be located in the river valley and will generally be small structures thus causing insignificant impacts. The powerlines will hopefully use wooden poles and if the penstock is not of shiny materials, the scenic impacts on the environment will remain medium low and insignificant.

- **Effects on health**

Olewa Hydropower Scheme is to be located in the sub-counties of Katrini and Aiivu in Terego counties and in Maracha county. However, potential impacts are identified in the two sub-counties in Terego county. As discussed in section 4.0, under the heading "Project Description" the Olewa Scheme Phase I for which this study is subjected will have no reservoir. It will be a run-of-river scheme and therefore will not require a reservoir. Accordingly, less health problems are anticipated especially in the short-term. The long-term that is not the terms of reference of this study may require a

reservoir and therefore may require a fresh EI Study. The project area has endemic malaria; schistosomiasis problems already and so will not result from project development. The only anticipated health problems due to project activities will be the fear of electrocution caused by the power lines to people living near them especially children, when poles or wires break for one reason or another, similar cases have been reported across the county and this could happen in Terego county as well. But this too can be minimised by effective powerline monitoring. Impacts in this area is therefore minimal and insignificant.

- **Effects of increased population size**

When project development of the Olewa scheme begins, there is a likelihood of Terego County and more specifically, Aiiyu and Katrini divisions experiencing an influx of unspecified number of outsiders. Most of this will be looking for employments. Such an influx of outsiders will have socio-economic impacts on the local environment including the following:

- (i) pressure on existing resources and infrastructures.
- (ii) pressure on existing institutions e.g. a small town such as Wandu or village institutions such as LCs.
- (iii) Increased pressure on health and sanitary facilities due to increased incidence of contagious diseases or waterborne diseases. There is only one health centre and one private dispensary in Aripea. These health units are far placed from most of the parishes in the project area. Latrine coverage in the area is 60% while water and sanitation conditions are inadequate.
- (iv) Breakdown of traditional methods of social control and discipline as well as social disorientation of local population due to external influence.
- (v) Increased marginalisation of the minority groups especially women and youth in the local population and widening of the existing poverty gap.

- (vi) Boom towns which are associated with construction projects will develop in the area. This is likely to cause social problems including breaking of marriages, over drinking of alcohol etc.

Project Traffic

If not properly organised, the construction process, often associated with fast moving heavy-duty vehicles, may create a serious traffic hazard. Since the project area is well settled with a good population of children aged between (6-13 years), medium negative impact caused by project traffic is likely to occur especially during the construction phase.

- **Effects on cultural property**

No known archaeological, historic, palaeontologic, religious and aesthetic or natural unique sites of importance has been noted nor reported in the sub-counties of Aiiyu, Katrini and Yivu. To this end the project will have no effects on any cultural property.

- **Indirect and off-site effects**

Indeed projects will not be restricted only to the immediate project sites. There will obviously be some indirect and off-site effects of the development. This will occur in the West Nile region in general and in Arua district and some neighbouring areas in particular. They will be both positive and negative in nature. This section discusses these effects.

6.2.3 Positive Impacts

Cultural integration

Skilled labourers who will be recruited mainly from outside Arua district are likely to export and spread new cultural values to the area. For example new culture of hardworking, saving, responsible drinking habits etc will be emulated by the local

people, who have remote ideas about these values. A market-oriented economy will emerge as opposed to the present subsistence agriculture. A demand driven economy will emerge especially for agricultural commodities. This will force the local people to work hard and produce more. Lodging business, which is untaught of as source of income is likely to be practised by a few wealthy persons in the project area.

- **Availability of essential commodities**

Lack of essential commodities have been reported in areas along the river valley due mainly to being far from Wandu trading centres, the nearest trading centre to the project site. This has been largely attributed to poverty, lack of access roads and transport. This situation is likely to change as many traders who will be demand driven will set up lock-ups and/or kiosks in the neighbourhood to supply essential commodities. Market for such goods will increase, as incomes of the local people will improve due to employment opportunities provided by the project. With improved road network in the area, transport of goods from Arua to the project area will not be a problem.

- **Employment Creation**

The project will require a number of wage labourers during the construction phase, but few people will be needed to operate the power plant apart from few skilled persons. Other long-term employment opportunities may however, result from an expanded local economy.

The construction of the project and the presence of the labour force will increase the demand for food and basic consumer goods as above mentioned. This will be beneficial to farmers who can increase their produce and sell surpluses on the local markets. For a few people, the growth in retail business will provide opportunities to expand businesses such as restaurants, guesthouses, shops and stalls selling basic goods and small business enterprises.

The present population in the project area is poor and basic social services are inadequate. The project might act as a catalyst to improve the general welfare of the local people. The magnitude of impacts during project construction is expected to be medium positive and small positive during project operation.

Improved power supply in Arua district will increase investments in electrical equipment, which is inevitable, if electrification is to lead to increases in productivity.

Poor performance in schools in Arua district has been partly attributed to lack of electricity supply in schools and learning institutions and colleges near Arua town which receive supply for only four hours compared to 24 hour in similar educational establishments in other parts of the county. Once the Olewa scheme is developed electricity supply in most schools and colleges in Arua district will improve thus improving education standards in the district.

Power supply will enhance local demand for agricultural produce. Currently, agricultural crops are harvested and sold off unprocessed and yet some farmers would prefer to process their produce for higher values. Reliable power supply will stimulate them into small processing activities. People interviewed contended that they will not sell tobacco to BAT unless they set up the branch of the Kampala factory in Arua. In this way cigarette prices are expected to be lowered down and more employment creation in Arua.

Communities are yearning for cold storage facilities, car-battery charging, baking, photocopying (presently 300/- per copy compared to 50/- in Kampala), refrigeration and recreational facilities are limited and expensive. These will expand once power supply becomes reliable and in abundance; hence increasing people's incomes and quality of life.

Upcountry communities such as in Arua, suffer higher prices because power supply and transport costs are higher. Power supply will lead to a reduction in transaction costs and the prices of customer goods and production inputs.

There is plenty of timber in the region especially from neighbouring DRC and Southern Sudan, but carpentry activities are limited due to lack of adequate power supply. Once the Olewa hydropower project is developed, power supply made available, the timber industry is likely to prosper.

With limited power supply in hospitals, emergency cases in the hospitals and major health centres are often fatal

With improved power supply to hospitals and health units, the quality of health services will improve.

Water pumping in Arua town is presently under capacity due to unreliable power supply. This will improve and other urban centres will benefit from the extension of such services.

Firewood is used by most households while charcoal is limited to a small urban population. Diesel and solar generated power are available for those in higher income brackets and in urban centres. The bulk of the population use small quantities of kerosene for lighting. With reliable power people will watch television, listen to radio broadcasts and have more study time for their school going children whose academic performance will improve. They will benefit from media education programmes etc.

Presently, the cost of running diesel generators in Arua sub-station is 3.7 million shillings a day, due mainly to expensive diesel prices and yet power supply is for four hours only and restricted to Arua town and only of recent to Bondo. This will improve once the Olewa scheme is developed. Thus reducing overall government expenditure on service provision.

The towns of Koboko and Yumbe have not been connected to the Arua grid. This is likely to change once the Olewa hydropower scheme is developed. These fast growing towns will benefit enormously from this project thus improving the socio-economic conditions of the communities in those towns.

6.2.4 Negative Impacts

Extraction of materials from quarries/borrow pits and canal involve site clearance, movement of large construction materials from local sources to the construction site which will result in significant quantities of wastes or eroded materials, and causes changes in topography or ground surface relief features. Mounds excavated pits are deep and can present a lot of risk to both animals and human beings. While earlier studies have not shown where quarry for construction will be obtained from nor the potential borrow pit location, these are expected to be located more than five kms away from the project site. If proper mitigation measures are taken by the developer, the impacts could be significant to the local environment. Impacts include but not limited to

soil degradation and consequent soil erosion, public nuisance caused by trucks transporting debris, road safety risks, dust pollution e.t.c.

Health and other social impacts.

Social rifts and rivalry caused by cash-rich camp men will also be experienced not only at the workers' camp but as far as Arua town. Insecurity, prostitution and increased incidence of sexually transmitted diseases including HIV/AIDS are also likely to spread over a wide range of area due to increased movement of workers at the project site.

Water Pollution

If not controlled, water pollution during and after construction can occur and will be experienced far down stream. This can result in significant health problems for both human and animal population down stream thus posing negative indirect and off-site impacts of the development of the Olewa Hydropower project in the West Nile region..

7.0 MITIGATION MEASURES

There are few negative impacts identified in the chapter 6 above and, the overall indication is that none is of major environmental/ecological significance. This is because all potential impacts can be mitigated and below are such measures as recommended by this study. Some, can be avoided without having to change the fundamental design and/or location of the project. This chapter identifies possible mitigation measures and strategies for the various negative impacts and how the positive aspects can be enhanced.

7.1 Surface Runoff

In order to reduce erosion and sedimentation caused by the project activities it is recommended that there should be minimal site disturbance, establishment of controlled/check drainage, protection of drainage at soft spots, reforestation of exposed surfaces especially along the river and channel. If clearing of sensitive slopes and land adjacent to the river is necessary, it should be done by hand clearing. The current methods of farming practiced by the local communities along the river are poor and the farmers should be persuaded to change their methods of farming.

7.1.1 Hydrology

There will be loss of water through evaporation especially within the 100m Channel running from the Balido bridge on Arua-Koboko road to the powerhouse. Sufficient management of catchment area will be required in order to reduce impact this would create. Besides, as indicated by DWD officials during our consultation process of this study, 15% water is to be retained in the river after diversion and/or abstraction from the said point to the powerhouse. Tree planting is recommended in the catchment area for sustainable natural resource use and management. It is also recommended that a tree-planting and education programme be undertaken for fuel-wood, poles, tobacco curing. There should be a cross-boarder approach to the planned catchment management as river Enyau originates from the DRC. Targeted population for the recommended measures should include the Congolese and their Ugandan counterparts in the project area since these are likely to impact negatively on the catchment areas.

Water for construction should be drawn from down stream instead of drawing from upstream especially if the construction will be done during the dry season. There should also be provision of adequate drainage during construction, culverts, spillways and embankments to avoid pollution.

It is acknowledged that the construction of the dam will result in reduced river flow along the 4.2 km stretch between the intake and the outlet. The changes will be most pronounced in the dry season when the largest proportion of the river flow will be diverted into the channel. Parts of the riverbed will become dry at least in the dry season reducing potential available habitats for aquatic life. This section is currently cultivated areas but fortunately river Enyau has very low aquatic life. Nevertheless, leaving a reasonable amount of water flowing through the river course could reduce the impact on the minimal aquatic life that is present. As stated earlier, DWD may require that the Developer retains 15% of the long-term amount of normal water flow in the river despite the fact that aquatic life is minimal in the river.

7.1.2 Pollution

The most likely source of watercourse pollution is sedimentation. In the reservoir the still water may also cause increased Salinization, eutrophication from biomass, turbidity and domestic/future industrial pollution. If the contractor exercises good environmental practice most of the risk including fuel and oil spillages into water courses should be avoidable. Construction camps, stores, vehicle repair workshops and other possible sources of pollutants should not be sited near watercourses. Any removable material that falls into a water course should be scooped out immediately. All scrap and solid waste materials should be buried or incinerated. Fuel should be transported in tanks instead of drums and stored in specified places. Refuelling, oil changes and lubricating mobile equipment should be done on a pad that drains into a temporary retention pond. It is anticipated that with development of power in Arua, more industrial activities will emerge. A monitoring and environmental audits need to be enforced strictly.

7.1.3 Borrow Pits and Quarries

To minimise land take and its effects, operational nuisance, post closure hazards and health and visual impacts, it is recommended that all borrow pits and quarries be

operated in accordance with a plan to be agreed upon between the developer, Ministry of Energy and Mineral Development and NEMA. Each plan should include:

- (i) plans for consultation with the farmer/land user, community members and other stakeholders;
- (ii) the extent of each pit/quarry should be clearly marked on the ground;
- (iii) compensation agreement, to be signed with the farmer;
- (iv) access arrangements must be agreed;
- (v) a work plan giving an outline of the direction, timing and depth of work prepared; and
- (vi) a site restoration plan, giving details of final shape, method of achieving its drainage and sediment control re-soiling and re-vegetation measures.

Borrow and pits quarries should be sited such that they cause minimum environmental damage. They should not be within 1000m of a water course, nor of human habitation. If possible, they should not be in conflict with existing land use and should be hidden from the main road. There must be only one agreed access to each site.

When transporting materials to and from the construction sites, there should be minimum disturbance by the haul traffic. They should observe set speed limits and the materials should be securely covered by tarpaulins to reduce the amounts poured along the road. Otherwise, this can become a nuisance to other road users.

Before extending an existing pit or opening a new one, top soil should be stripped and stock piled separately for eventual use in site restoration. Slopes should be monitored to see whether natural vegetation occurs and if not, appropriate species should be planted. Pits should be regraded to a shape that will not hold water.

Special care must be taken with blasting and the siting of quarries. The developer should be responsible for compensating the owners of affected structures of property should their blasting cause damages. The contractor in order to minimize health hazard to the local community must control all potentially dangerous, loose forces.

No wastelands should be created as a result of this project because if not satisfactory restoration is done, the National Environment Statute will be involved and the developer

penalised. All procedures regarding penalisation are now in place and effective unlike before.

It is likely that most construction materials apart from sand, cement, timber and iron bars will be secured from the power house, tunnel and weir sites. If this is so, then the effect of borrow pits and quarries on the environment will be minimal.

7.1.4 Construction Camps

Many potential impacts related to such camps can be mitigated. The contract document must make it clear that for all construction camps, the developer is responsible for undertaking the following to the satisfaction of the MEMD, NEMA and DEC.

- (i) the land must be acquired in accordance with specified guidelines including requirements for full restoration unless the developer requires the camp to be left. In which case, land take, and this must be clarified in the agreement with concerned parties at the outset, must be comprehensively compensated.
- (ii) adequate supply of water, treated to WHO standards
- (iii) an effective sewage disposal system, either water born using septic tanks; or for very small camps, pit latrines.
- (iv) A continuous electricity supply and/or supply of cooking fuel for workers and the means to use it. No wood and charcoal only if it is eucalyptus.

A waste disposal systems that separates oils and grease from other wastes.

- (v) All oil and vehicle fuel must be stored in a banded enclosure of a capacity such that the complete contents of the tanks can be contained with no leakage, seepage or fire disasters.

When restoring campsites, special attention should be paid to all concrete surface, open pits, septic tanks and other non-biodegradable material whose traces must be removed.

The developer should establish an open system for dealing with local health authorities to extend their services to camps e.g. Arua or Maracha Hospitals/ Chillio health centre. Such an arrangement should be established with the aim of controlling rampant diseases such as HIV/AIDS. Provision of condoms, awareness building programmes on how to use them and general hygiene measures must be part of the services to be provided.

All workers should be provided with protective wear where applicable in order to ensure their safety. These will include head protectors, noise and mouth masks, waterproofs and many others. The developer should ensure that all workers are safe while at work.

7.1.5 Project Traffic

If not properly organised, the construction process itself may create a serious traffic hazard. Sensible forward planning, of designed features proposed to improve safety on the roads must reduce any such hazards:

- (i) erection of visible and well printed road signs before every hazard such as settlements, sharp bends, bridges, bill crests, cattle farms etc. Marker posts should be used;
- (ii) before settlements and at any danger point, a combination of rumble strips and road humps should be used in conjunction with warning signs, to ensure that speeds are reduced; and
- (iii) the developer should ensure that all these measures are adhered to.

7.2 Socio-economic

7.2.1 Land-take

A detailed compensation plan has to be drawn to identify individuals/families, which will have lost their land due to project development.

- Compensation should be for both land and crops as well as for other properties such as valuable trees.
- Raise the level of the Balido bridge by 2 metres.
- Resettlement and compensation

As mentioned earlier, there will be no displacement of homesteads so to require involuntary resettlement plan. However, for those who will lose farmland due to project developments comprehensive and fair compensation for farmland, crops and other property be carried out. This should be done according to international standards (WB) and with the overall objectives of improving the standard of living for those who will be affected. All crops, valuable trees such, as eucalyptus trees should be replaced. Cash compensation is the mode agreed with the people in Katrini, Aivuvu and Yivuvu sub-counties during consultations.

Measures to optimise positive impacts:

- (i) The developer should recruit non-skilled labour only from the local communities and in close cooperation with the LCs as long as required skills are available. The youth in the project area have expressed their eagerness to find employment with the project.
- (ii) Like most rural communities in the country, the local population, in the project area lack adequate resources to take full advantage of the changes the project will cause. Rotating credit schemes for businesses and local entrepreneurs and cooperation with local authorities to tackle the new situation would allow for greater benefits to the local population. CEFORD, a local NGO based in the district should be contacted over this issue. This should be set up well before the project commences in order to reap maximum benefits.
 - Cooperation with local and district authorities regarding improved infrastructural development could enhance mitigation measures dealing with health, drinking water supply education, electricity supply and general social uplift. This means the project could become development opportunity with long-term, positive implications for the project area and the region as a whole.

7.2.2 Construction camps, work yards and stores

Provide safe water, effective sewage disposal system, sustainable source of energy, while their location should also be planned in advance to minimise disruption to local communities.

- Standard practice requires either dismantling of the camp and full restoration of the site or its handover to the local authority/communities.

7.2.3 Effects of increased population size

These should address problems related to spontaneous immigration and minimise the need for masses of temporary workers from outside Terego/Maracha counties in Arua district.

- Train local people before hand especially for less skilled jobs, making special efforts to train local people and improve transport facilities to and from the site to enable local people to work at those sites. This can be undertaken by the LCs in the area with assistance from the District Local Government of Arua.
- When budgeting for new infrastructure and services, plan adequately for the voluntary immigrants as well as the known numbers of construction workers.
- Promote investment in local resources (e.g. fish ponds, vegetable growing) to improve local resources base and capacity to produce food and services for sale to the immigrants; to reduce pressure during boom period; and to buffer the population against economic bust, which follows. Again LCs in the sub-counties of Katrini, Aiiyu and Yivu can do this with assistance this time from NGOs such as CEFORD and the Churches.
- Locally, strengthen existing institutions or develop new ones to undertake long-term development and planning that addresses changes, handle an increased number of social problems and to accommodate a much more diversified population. Arua district authorities should call upon relevant NGOs to assist in this process.

- Plan adequate health, drinking water and sanitary facilities to deal with the unexpected rise in disease incidence and pest outbreaks.
- Provide the necessary social psychological and counselling services to old and new residents to enable them cope with socio-economic changes, particularly for vulnerable groups and the aged.

7.2.4 Project Traffic

The following plans are recommended for this impact.

- Erection of visible and well-printed road signs before every prone hazard area such as settlements, sharp bends, bridges, bill crests, cattle farms.
 - Raise the level of the Balido Bridge by 2 metres.
- (i) Before settlements and at any danger locations a combination of rumble strips and road humps should be used in conjunction with warning signs to ensure that the speeds are recorded.
The developer should ensure that all these measures are adhered to.
- (ii) Clearing for construction activities and roads shall be confined to those areas designated and marked. Construction vehicles should be restricted to the access roads and facility sites only. The construction area should be fenced off so as to reduce the risk of accidents especially among vulnerable groups such as children and disabled persons.
- (iii) Access roads should be designed with gentle curves for safe movement of large vehicles. Speed limits should be clearly posted and enforced and speed humps constructed especially near settlements, schools and churches e.g. at Burua Church in Katrini sub-county. A traffic safety programme should be designed and implemented, to avoid accidents and facilities and also be worked into curriculum at the local schools near the Olewa Scheme where possible.

General Comments

- (i) It is recommended that engineering requirements regarding drainage/erosion prevention and construction techniques for all construction actions and access road construction be strictly enforced, with the engineer on site having the possibility of stopping work until satisfactory procedures are used. These will include the provision and maintenance of suitable drainage networks, slope control, construction of re-vegetation of exposed surface and protection of surface prone to subversion by water.
- (ii) All locations and procedures used for quarries, borrow pits and rock and soil disposal sites should be identified and discussed before hand to ensure that the impacts of these site disturbances are minimised and that natural drainage is not disturbed.
- (iii) All waste materials, garbage and debris shall be removed and disposed of by incineration or land filling, whichever is appropriate.
- (iv) Fuel should be stored in specified areas only. Refuelling, oil changes and lubricating mobile equipment should be conducted on a pad that properly drains into a temporary retention pond.

The compensation rates were obtained from Arua District Land Board

Table 9 Compensation Estimates Including Land

CATEGORY A: Crops

No.	Item	Quantity	Rate (shs)	Amount (shs)
1.	Tobacco	6 acres	1,000 pe plant	6,000,000
2.	Cassava	18 acres	250,000 per acre	4,500,000
3.	Sweet Potatoes	5 acres	200,000	1,000,000
4.	Groundnuts	2 acres	450,000	900,000
5.	Maize	5 acres	250,000	1,250,000
6.	Sorghum	3 acres	150,000	450,000
7.	Beans	10 acres	250,000	2,500,000
8.	Millet	4 acres	250,000	3,200,000
9.	Simsim	10acres	400	16,000,000
10.	Fruit trees	2 acres	450,000	900,000
11.	Mango	5 acres	45,000	225,000
	Sub-total			

CATEGORY B: Forest products

12.	Eucalyptus	60 trees	50,000	3,000,000
	Sub-total			3,000,000

CATEGORY C. Buildings and Physical Infrastructure

No.	Item	Quantity	Rate (shs)	Amount (shs)
13.	5 Grass thatched (mud and wattle)	25 sq.metres	10,000	2,500,000
	Sub-total			7,300,000

CATEGORY D. Bare Land

No.	Item	Quantity	Rate (shs)	Amount (shs)
14.	Land	60 acres	400,000	24,000,000
	Sub-total			24,000,000
	GRAND TOTAL (A, B, C and D)			66,425,000

Compensation

The project will be situated in cultivated areas, and so, project development will affect farmland in the area. Project development likely to cause loss of farmland include construction of access roads, workers' camp, power house and the canal. Right from the Burua church to the project site, the area is heavily cultivated which will be destroyed as project work progresses. It means therefore, a fair and comprehensive compensation for loss of crops during construction be done to the owners of the gardens.

During meetings with the local communities, it became clear that an estimated 60 acres of cultivated land will be affected. Crops cultivated on the land include tobacco, cassava, sweet potatoes, groundnuts, maize, sorghum finger millet, simsim, and fruit trees. It is however not certain as to how many homesteads will be affected especially due to the construction of access roads ie. from Burua Church to the site and perhaps due to the creation of workers' camp. Conservative estimates put it at 5 homesteads. This too will have to be considered for compensation. The idea of relocation was rejected by the communities even if there will be dislocations.

Therefore, calculations indicate a total of **62 acres** (or 25 hectares), which will potentially be affected. However, this estimate should be regarded as upper case since the planned construction work is likely to impact less area than what the communities perceive. Secondly, except for the perennial ones, some of the crops presented for compensation are annual and by the time project implementation begins would have been harvested. There were no estimates for bare land rates. However, from discussions with area residents, an acre of bare farmland was said to be in the range of Ushs.250,000 to Ushs.500,000 in the project area, selling, while leasing per season is in the range of Ushs.150,000 to Ushs.200,000 per year. Leasing is common in this area due to the scarcity of land and people lease mainly for growing tobacco. An average of Ushs.400,000 per acre in this rural part of Arua District is considered reasonable for purposes of indicating the possible magnitude of compensation. Subsequently, compensation for bare land would be about Ushs.24 million. In addition, compensation would also be required for improvements and crops on the land. These estimates are presented in Table 9 and a detailed list of potential claimants presented in Annex 2. In summary, therefore, a upper case provision for compensation has been estimated as follows:

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	Ushs.	Amount USD
Land	24,000,000	14,117
Category A (Crops)	60,925,000	35,838
Category B (Forest products)	3,000,000	1,764
Category C (Buildings, Physical Infrastructure)	2,500,000	1,470
Total allowance for compensation	90,425,000	53,191
* 1 US Dollar equivalent to Ushs.1,700		

TABLE 10: IMPACT - EFFECT MITIGATION/ENHANCEMENT MATRIX FOR CONSTRUCTION OF OLEWA HYDROELECTRIC POWER

SECTOR ACTIVITY	POTENTIAL IMPACTS	EFFECTS	MITIGATION MEASURES	RESPONSIBILITY
A.	Negative Impacts			
Hydroelectric project: <ul style="list-style-type: none"> • Equipment mobilisation • Construction of a dam, reservoir, canals, powerhouse and transmission line • Establishment of workers' camp Access road construction:	1.Surface Runoff	<ul style="list-style-type: none"> • Soil Erosion • Gulying • Siltation • Increased sedimentation 	<ul style="list-style-type: none"> • Minimal site disturbance • Controlled/check drainage • Protect drainage in soft spots • Slope control • Re-forestation of exposed surfaces • Maintenance of suitable drainage networks • If clearing of sensitive slopes and land adjacent to the river is necessary, it should be done by hand clearing. 	Contractor/D eveloper Contractor/D eveloper Developer Devolooper Developer Developer
<ul style="list-style-type: none"> • Bush clearing, Road widening • Surface compacting, reshaping, regravelling and excavating. • Establishment of a reservoir 	2. Land Use	<ul style="list-style-type: none"> • Vegetation destruction • Destruction of wildlife habitats 	<ul style="list-style-type: none"> • Restore some of the destroyed sites. • Establish long-term procedures for reducing soil erosion around the reservoir e.g. modern methods of farming • The construction area should be fenced off to avoid any unplanned, additional grabbing of land and reduce the risk of accidents. • Clearing for construction activities and roads shall be confined to those areas designated and marked. 	Developer Arua District Developer Developer

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	3. Hydrology	<ul style="list-style-type: none"> Loss of available surface water 	<ul style="list-style-type: none"> Draw water away from settlement and animal watering holes Protection of surfaces prone to submersion by water. 	<p>Contractor/Developer</p> <p>Developer</p>
	4. Quarries /Borrow Pits	<ul style="list-style-type: none"> Large quantities of materials removed Vegetation destruction Large gaping holes <p>Visual nuisance</p>	<ul style="list-style-type: none"> Site restoration after construction Sites used for quarries, borrow pits and rock and soil disposal sites should be identified and discussed before hand. Guard protection thereafter site restoration. Locate pits away from main roads 	<p>Developer</p> <p>Developer/ Arua District Authority</p> <p>Contractor/Developer</p> <p>Developer</p>
	5. Pollution	<ul style="list-style-type: none"> Dumping Dust Water pollution Oil spills <p>Noise pollution</p>	<ul style="list-style-type: none"> Dump used oil outside park Bury scrap and solid waste materials or incinerate them. Transport fuel in tankers instead of drums. Fuel shall be stored in specified areas. Refueling, oil changes and lubricating mobile equipment will be done on a pad that drains into a temporary retention pond. 	<p>Developer</p> <p>Developer</p> <p>Contractor/Developer</p> <p>Contractor/Developer</p>
	6. Workmen's Camp	<ul style="list-style-type: none"> Firewood extraction Organic pollution/garbage 	<ul style="list-style-type: none"> Draw water away from settlements and animal watering holes Bury solid waste 	<p>Contractor/Developer</p> <p>Contractor</p>

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	7. Road Safety	<ul style="list-style-type: none"> Improved road safety Greater traffic efficiency Reduced vehicle operating costs Accidents 	<ul style="list-style-type: none"> Access roads should be designed with gentle curves for safe movement of large vehicles Speed limits should be clearly posted and enforced and speed bumps constructed. 	<p>Developer</p> <p>Contractor/ Developer</p>
	8. Flora	<ul style="list-style-type: none"> Loss of indigenous species 	<ul style="list-style-type: none"> Plant indigenous species to restore destroyed sites 	Arua District/ Developer
	9. Aquatic Ecosystems	<ul style="list-style-type: none"> Possibility of introduction of alien fish and plant species to reservoir Increased sediment load 	<ul style="list-style-type: none"> No foreign species of fish should be introduced into the reservoir and the river. Monitor for the possibility of introduction of the water hyacinth 	<p>Developer</p> <p>Arua District Environment Office</p>
	10. Land take	<ul style="list-style-type: none"> Change in land use Change in land terms 	<ul style="list-style-type: none"> Fair and appropriate compensation at favourable intervals 	Developer
	11. Visual intrusion and aesthetics	12. Minimal	<p>13. Landscape enhancement through planting of hedges</p> <p>14. Buildings to be finished with bricks and appropriate roofing</p>	<p>Developer</p> <p>Developer</p>
Construction of dam, creation of reservoir, access roads	Displacements at damsite and those which will have remained with non viable plots when parts of their land is taken permanently	15. Minimal	<p>16. Adequate compensation</p> <p>17. Hardship /resettlement allowance</p>	<p>Developer</p> <p>Developer</p>
Creation of reservoir	12. Water borne diseases e.g. bilharzia, malaria etc	<ul style="list-style-type: none"> Depopulation <p>18. Weak and unhealth people.</p>	<p>19. Community education and awareness.</p> <ul style="list-style-type: none"> Health programmes to eradicate the disease already in place. 	<p>Developer/ DEO-Arua Arua District Local Government</p>

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Creation of employment during project construction phase	13.Un-expected population influx to Paidha and Okoro county in general.	<ul style="list-style-type: none"> • Pressure on meagre resources. • Altered social order population increase 	<ul style="list-style-type: none"> • Most employment opportunities should be given to Okoro county residents . • Plan for them especially workers: infrastructure such pit latrines, safe water, security measures etc. 	Developer
Project development	B) Positive Impacts			
	14.Improved road communication	13. Easy access	14. None	
	15.Enhanced energy source	<ul style="list-style-type: none"> • Easy access to Hydropower 	<ul style="list-style-type: none"> • None 	
	16.Employment creation	<ul style="list-style-type: none"> • Increased income and better quality of life 	<ul style="list-style-type: none"> • Give jobs to those in the project area 	Developer
	17. Emergence of agroprocessing small scale industries	<ul style="list-style-type: none"> • High value for agricultural produce and employment creation 	<ul style="list-style-type: none"> • None 	Developer

8.0 ANALYSIS OF ALTERNATIVES

The analysis of alternatives is part of the EIA process. The purpose is to ensure that the best among all possible options is selected. However, this analysis is based on the predetermined option for Phase I of the development of the Olewa run-off-river scheme which is the basis of this EIS study and the bidding process underway for the selection of a successful private developer. The alternatives analysed by this study include the siting of works and power line routes, technology selection, construction techniques, and operating and maintenance procedures. The alternative of not carrying out the proposed project is discussed (as required by World Bank OD 4.0 and NEMA Guidelines) in order to demonstrate environmental conditions without the project.

8.1 The “do Nothing” Scenario

The ‘Do Nothing’ scenario is assessed under three headings, namely: source of energy, scheme characteristics, and choice of the site.

Uganda is a low commercial energy consumer, despite the fact that the country has substantial hydropower potential. Currently, Uganda’s total energy consumption is overwhelmingly based on biomass resources. This over dependence on biomass is already causing severe land degradation through deforestation. Furthermore, the current electricity being generated in Nebbi and Arua towns use diesel fuel, which is very expensive and not environmentally friendly in the long run. Therefore, without this project, there is no other better source of energy given the current situation.

The scheme characteristics of Olewa are the most appropriate given the existing environmental setting in this project phase. At its full capacity the proposed scheme would allow for an installation capacity of 2.0 MW without any major adverse impacts on the environment. The current proposed run-of-the-river scheme (Phase I) is environmentally benign.

Currently, the five districts of the West Nile region (Adjumani, Arua, Moyo, Nebbi and Yumbe) are not connected to the national power grid. A number of mini and micro hydropower sites have been identified with Olewa presenting the second biggest potential after Nyagak and hence its development represents an optimum choice.

8.2 The proposed Development Scenario

The second alternative is to implement the proposed development. This alternative is described under the headings: siting of the power station; siting of the storage dam; power line routing; and operation and maintenance.

8.2.1 Siting of the Power Station

The siting of the power station on Enyau River was extensively discussed with project engineers to establish the criteria used to choose the site. Based on previous reports, photographs and maps plus data from drill hole cores and geologic logs, the feasibility assessment team was able to confirm the present site as the most suitable. In addition to having a strong bedrock foundation, the station is close to Wandi where the Arua line stops thus requiring a short distance for extending the existing transmission line to the site. The site selected is currently an open area of grass with some mature trees and limited settlements mainly on the hilltops. There are a few gardens of mainly seasonal crops such as beans, and sweet potatoes. Alternative sites for the power station were discussed within the area and this one was selected because it provided the best gradient at which to receive water from the upsurge tank and be able to generate up to 2.0 MW (maximum installed capacity). However, landscaping will be required to minimise adverse visual impact.

8.2.2 Siting of the Storage Dam

A canal will be constructed in order to maximize storage of water for generating the required capacity of 2.0 MW. Unless at a later stage no dam is included in the present phase of development. In which case a separate EI Study will have to be carried out. The foundation of the proposed site is suitable for either an embankment structure (earth core rock fill, homogenous earth fill, or concrete faced rock fill) or a concrete gravity dam.

8.2.3 Power Line Routing

There is a very short distance from Wandi to the proposed Powerhouse, which will require installation of a power line. The line will follow the existing road and placed within the road reserve to minimise temporary disruptions to settlements.

8.2.4 Operation and Maintenance

The contract for the construction works should ideally be let out to a single contractor rather than being split into several parts. This would ease supervision. The same contractor would be responsible for all development works up to the powerhouse. On the other hand, any widening of the road from Burura Church to the powerhouse and the installation of the remaining transmission line along the same distance will be the responsibility of the licensee. It is likely that local workforce will be used for the works, with import of labour where necessary. This will further reduce the size of the labour camps and also provide badly needed local employment in the project area.

9.0 ENVIRONMENTAL MANAGEMENT AND MONITORING

9.1 Introduction

As the implementation of the Project proceeds, a monitoring process will need to be put in place to check progress and the resulting effects on the environment. Much of the work during construction stages can form part of the routine inspection of contractors' work that will be included in contract monitoring. Recommended measures identified in Chapter 7 should, therefore, be part of the contractual items to be checked against their effectiveness in reducing the negative impacts and/or enhancing the benefits identified in this report. The process should also include regular reviews of the impacts that cannot be adequately assessed before the start of the works, or which arise unexpectedly together with undertaking appropriate new actions to mitigate any negative effects.

There are several other aspects of environmental management and monitoring which need to be developed as a consequence of the project. They include:

- the effects of soil erosion, deforestation and/or general land use change upstream as population increases in Aiiyu, Katrini and Yivu Sub-Counties as well as in Terego and Maracha counties in Arua district.
- the effect of increased water-borne diseases especially the potential threat of schistosomiasis (Bilharzia) which could at some time become a real danger if not monitored carefully, especially after the creation of a reservoir during the second phase of the project.
- the effects of further land acquisition by the developer for the protection of and ensuring long life of the storage dam should the need arise.

These components require a broader outlook than routine monitoring of output and operational actions, and imply the need for a long-term planning and monitoring capability with emphasis on increasing demand for electricity and measures to prevent sedimentation occurring at a high rate. They also imply re-enforcing or creation of new

lines of coordination with other organisations/institutions involved with this project in one way or another.

9.2 Environmental Monitoring Plan

At present, there is no organisation in Uganda with the physical, human and financial resources to cover all the environmental issues that need to be addressed under various projects. In theory, NEMA has the remit to carry out most, if not all, of the types of environmental monitoring activities needed, but since it has very limited funds and cannot deploy its staff outside Kampala, it does not have the ability to do so. Similarly, although DEOs are technically responsible for environmental management at the local level, they have no adequate funding for assuming this role. NEMA can, through the DEO of Arua, enforce the national environmental quality standards to which the developer must adhere.

The district itself must, therefore, take the initiative in undertaking the necessary management and monitoring measures, although close links should be maintained with other relevant agencies. To achieve the environmental monitoring and management objectives, a two-stage programme is proposed.

- Stage I: Short term Programme: A short programme aimed at monitoring the environmental impacts of the early stages of the project implementation, with particular emphasis on the construction and operation of hydro-electric power supply infrastructure.
- Stage II: Long term Programme: A new evolving long term and action programme to include the developer's activities and the wider implications of future hydropower development plans. Subsequent expansion should cover the broad environmental interactions of all the developer's activities. This should proceed jointly with initiatives by the Wetlands Programme, Directorate of Water Development and DEC to assist in an integrated approach to environmental management and monitoring of water resources, which is currently being developed by NEMA.

9.3 The Environmental Monitoring Programme

9.3.1 Short-term environmental monitoring programme

The short-term monitoring programme is aimed at establishing the framework within which the developer's environmental activities should proceed during construction of reservoir, weir, power station, transmission lines, and access roads.

Various activities, therefore, need to be undertaken immediately on completion of this study and before implementation begins:

- the establishment of a project monitoring team made up of NEMA, ERA, MoEMD, District Environment Office, DWD and District Land Board;
- identification of an individual within the District Environment Office of Arua and made responsible for environmental monitoring and management;
- contracts must be reviewed by the Electricity Regulatory Authority in terms of the environmental issues identified in this report; and
- general environmental issues applying to the developer must also be reviewed and an out line of further actions drawn up.

Programmes should also be drawn up for the following elements:

- implementation of the mitigation plan presented in Chapter 7, to be undertaken by the developer and the contractor in coordination with Arua district authorities such as the DEC and/or sub-county environment committees,
- review of future developments and plans laid in preparation for mitigation of future environmental impacts. This should include, for example, early acquisition of land for future plants, and definition of river or ground water protection measures; and

- formulation of detailed monitoring activities to be undertaken during contract implementation (regular environmental monitoring reports could be circulated).
Some recommendations for this are included in **Table 10**.

Table 10 Short-term Environmental Monitoring

Issue/Component Requiring Monitoring	Environmental Indicator
Control of noise, dust, vibrations during construction	<ul style="list-style-type: none"> - record of noise levels against national standards when developed. - control of working hours - record of complaints from the public - record of properties affected
Health and safety of workforce and public	<ul style="list-style-type: none"> - record of accidents
Land cover protection during construction	<ul style="list-style-type: none"> - evidence of protected trees - records of compensation planting
Severed communication due to raised water level	<ul style="list-style-type: none"> - number of new bridges across the river
Compensation for land and crop losses	<ul style="list-style-type: none"> - record of compensation paid - attitudes/and situation thereafter of the affected people
Restoration of camps, borrow areas and quarries and dumped spoil	<ul style="list-style-type: none"> - actual visits to the sites - record of complaints from the public

A mid-term review of the contracts in relation to these and the other environmental issues is recommended. This should be scheduled at a mutually convenient time at the mid-point of the contract with the objective of reviewing environmental monitoring and management activities to date and to formulate recommendations for improving these where necessary, during the remainder of the contract. A secondary objective would be to make recommendations for long-term environmental monitoring requirements.

A subsequent Final Review would have similar objectives: (a) to review the experiences of contract implementation and formulate recommendations both for contents of, and specifications in, future contracts; and (b) to draw up recommendations for long-term monitoring. This should also include a review of the organisational arrangements with Electricity Regulatory Authority (ERA).

Responsibility for implementation of the above recommendations should be allocated to the individual identified within DEO–Arua for environmental monitoring and management.

9.3.2 Long-term environmental monitoring

Depending on the outcome of the Review, and of the proposed expansion studies, long-term environmental monitoring arrangements will need formulation to ensure that there is a suitable Master Plan (or equivalent), well coordinated with the plans of other organisations. The programme should be drawn up in light of the success (or otherwise) of inter-agency cooperation. By the time the long-term programme is drawn up, it is hoped that there will be several major improvements to the present situation:

- the enforcement of environmental quality standards; and
- a stronger DEC, and perhaps sub-county environment Committees in terms of both physical and human resources and its ability to enforce standards with support from NEMA. Arua has been selected as one of the focus districts by NEMA's institutional support programme and this should improve its capacity in most aspects.

The long-term planning programme should be formulated by ERA in light of these developments and in close coordination with NEMA. Suggested components of the Environmental Monitoring Programme are detailed in Table 11.

9.4 Management of Environmental Aspects

9.4.1 Overall management

For optimum effect, any environmental management programme should be carried out as an integrated part of project planning and execution, making a significant contribution to the overall development of the scheme. It must not be seen merely as an activity limited to monitoring and regulating activities against a predetermined checklist of required actions. Rather, it must interact dynamically as project implementation proceeds, dealing flexibly with environmental impact – both expected and unexpected – as they arise.

For these reasons, it is recommended that the responsibility for environmental matters for the project be retained by senior staff, with the necessary executive powers at ERA, DEO/Local Government Arua to ensure that actions are taken on impact mitigation and

benefit enhanced. However, given the lack of experience of environmental management and monitoring within the organisation, it is suggested that experience be brought in from other bodies in the form of advice from NEMA, Health Inspectors and/or any other person(s) deemed appropriate, and specific training inputs be established within ERA and District Environment office - Arua with the assistance of these bodies.

Table 9.2: Long-term Environmental Monitoring

Issue/Component Requiring Monitoring	Environmental Indicator
Water quality of the river	- analysis of samples regularly - prevalence of water-borne diseases
Land use changes around the banks	- population density - records from Department of Agriculture (productivity)
Soil erosion/sedimentation	- state of land cover - colour of water in reservoir
Population increase	- growth rate - fertility rate
Loss of water through evapotranspiration	- pan evaporation rates - amount of power generated
Floods	- area periodically inundated - numbers of families affected
Water weeds (e.g. water hyacinth) proliferation	- area of reservoir under them - block of turbines incidents
Leakage in reservoir	- record of number of bursts - existence of faults - rate of soil erosion

9.4.2 Management of the short-term environment programme

It is recommended that the Project Coordinator or Counterpart Engineer be appointed within the company of the developer who will liaise with the DEO-Arua and take overall responsibility for the activities under the Short-term Environmental Programme to ensure that environmental aspects are accorded a sufficiently high importance. The individual should ensure that a detailed programme is drawn up concerning all the major environmental components, in conjunction with NEMA, with appropriate timings related to contract activities and delegation of responsibilities for each. The person should also provide support and guidance to the staff involved in the day-to-day operations.

The day-to-day operations should be delegated to the appropriate staff of the developer. For construction contracts under the current project, environmental responsibility should lie with a Resident Engineer and Project Coordinator as they will be responsible for contract supervision and will be in touch with day-to-day activities. Environmental aspects should form an integral part of their project management duties, and should be formally set out in their job descriptions, which should also contain a requirement for regular reporting probably on a monthly basis. The specified engineer will need to ensure that:

- a sufficiently detailed environmental guidelines for the supervision required is in place;
- full management and control of environmental monitoring is undertaken;
- they are sufficiently trained to carry out this supervision; and
- negative impacts of contract implementation are mitigated and any appropriate requirements are communicated to the Project Coordinator for appropriate action (e.g. for issue of variation orders to contractors).

The Project Engineer will also be responsible, through the Project Coordinator, for ensuring that environmental information from the project is shared with NEMA, so that the latter is able to gain a broad view of project development and the environmental consequences. Other organisations which should also be kept informed regularly include DWD, LCs and the Ministry of Lands, Water and Environment.

9.4.3. Management of the long-term environmental programme

In the medium to longer-term, it may prove possible for many environmental management and monitoring functions to be shared with other agencies (See Chapter 3). Monitoring and control of river water quality (with NEMA and DWD) is an example, the extent to which other organisations can realistically help must be actively explored during the project period and the results built into the long-term monitoring programme (Section 9.3.2.) At this stage, however, it seems unlikely that many of these organisations will be able to assist greatly with the specific data needed by the developer. They are, therefore, less likely to have a sense of urgency in defining and enforcing the relative environmental standards, and it is strongly recommended that the developer retains the lead responsibility for developing and supervising the long-term environmental programme.

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ANNEX 1

List of people likely to be affected by the development of Olewa Hydropower Scheme

1. Alini Zakaria
2. Ndebu Zakaria
3. Waga Charles
4. Zakayo Emayo
5. Tom Arikangelo
6. Alimani Arikangelo
7. Luiji Aloma
8. Polly Antonio
9. Drakumma Pius
10. Onzima Isaka
11. Butele William
12. Aduma Isaac
13. Ayub Drasiku

Annex 2

List of people consulted

	Name	Title/Place of work
1.	Okoth Thomas Nyalulu	RDC
2.	George Ambe	Vice Chairman
3.	Rt. Rev. Enock Lee Drati	Bishop, Madi and West Nile Diocese
4.	Eriku Cyril	District Speaker
5.	Adrabo Stanley	Deputy CAO
6.	Drasi Nuer	Secretary for Production Arua
7.	Christine Aciferu	Deputy Speaker Arua
8.	Drag Francis	Secretary for Works
9.	Inziku Paul	Deputy Town Clerk Arua
10.	Pario Lawrence	District Executive Engineer Arua
11.	Acuma Pius	Area Leaf Manager Arua
12.	Adnoku Odipio Edward	District Environment Officer Arua
13.	Enzama Wilson	District Economist Arua
14.	Ben	Manager Hotel Pacific
15.	Swali Rajab	Manager UEB Arua/Nebbi
16.	Driwale Fred	OZU Brothers Enter
17.	Sam Baker Kakonda	Radio Paidha
18.	Alioni Patrick	Media Plus
19.	Ajabo Joel	New Vision
20.	Amayo Wilfred	Clerk to District Council Arua
21.	Polly Antonio	Farmer
22.	Zakayo Udesi	Farmer
23.	Jeny Amazu	Farmer
24.	Charles Enaka	Farmer
25.	Pariyo Godfrey	Farmer
26.	Zakayo Erimayo	Farmer
27.	Alimani Arikanjelo	Farmer

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28.	Yode Trakuse	Farmer
29.	Tito Trakule	Farmer
30.	Ayikokua Gilbert	Farmer
31.	Stephen Luiji	Farmer
32.	Asagu Bernard	Farmer
33.	Mawa A.g. Benjamin	Farmer
34.	Arumadri Butele	Farmer
35.	Avako Night	Farmer
36.	Alezau Buce	Farmer
37.	Eseteri Driciku	Farmer
38.	Oroyo Monday	Farmer
39.	Moly Azucia	Farmer
40.	Onduma Gadi	Farmer
41.	Adiga Fabian	Farmer
42.	Onsima Isaac	Farmer
43.	Amazu Nato	Farmer
44.	Luiji Aloma	Farmer
45.	Rev. Yakobo Ine	Priest/farmer
46.	Eng. Badassa M.	Senior Hydrologist/Permit DWD
47.	Eng. Fred Kyosingira W.	Principal Hydrologist DWD

Annex 3

The following were debated and the rates approved.

i. FRUIT TREES/PLANTS

- | | | |
|-----|----------------------|--|
| 1. | Pawpaws | 30,000/= per tree mature/producing
15,000/= per tree young/medium
2,000/= per seedling |
| 2. | Guava | 30,000/= per tree mature/bearing
15,000/= per tree young/medium |
| 3. | Avacado | 45,000/= per tree mature/yielding
15,000/= per tree young/medium |
| 4. | Brother heart | 45,000/= per tree mature/yielding
15,000/= per tree young/medium |
| 5. | Passion fruit | 45,000/= per plant |
| 6. | Lemons | 40,000/= per tree mature/yielding |
| 7. | Banana | 10,000/= per dump/cluster |
| 8. | Oranges | 60,000/= per tree mature/bearing
30,000/= per tree young/medium
5,000/= per seedling |
| 9. | Mangoes | 75,000/= per tree (dodos or hybrid type)
yielding
45,000/= per tree (other types) mature /bearing
20,000/= - 30,000/= per tree young/medium |
| 10. | Yams (climbing type) | 2,000/= per plant |

- | | | |
|-----|-------------|---|
| 11. | Jack fruit | 60,000/= per tree mature/yielding
30,000/= per tree young/medium |
| 12. | Pineapples | 1,000/= per plant |
| 13. | Water melon | 10,000/= per plant |

(b) CROPS

- | | | |
|-----|----------------|---|
| 14. | Coffee | 10,000/= per tree mature/bearing
5,000/= per tree young/medium |
| 15. | Egg plant | 1,000/= per plant |
| 16. | Cassava | 3,000/= per stool |
| 17. | Sweet potatoes | 1,250/= per sq. metre |
| 18. | Maize | 150/= per stand |
| 19. | Finger millet | 200/= per sq. metre |
| 20. | Sorghum | 150/= per sq. metre |
| 21. | Beans | 500/= per sq. metre |
| 22. | Groundnuts | 500/= per sq. metre |
| 23. | Sugarcane | 3,000/= per stool |
| 24. | Simsim | 400/= per sq. metre |
| 25. | Tomatoes | 6,000/= per sq. metre |
| 26. | Onions | 1,500/= per sq. metre |

27.	Cabbages	200/= per head
28.	Grans	300/= per sq. metre
29.	Pigeon peas	200/= per sq. metre
30.	Cowpeas	400/= per sq. metre
31.	Soyabeans	400/= per sq. metre
32.	Yams (Mayuni)	1,200/= per plant
33.	Rice	500/= per sq. metre
34.	Bull rush millet	150/= per sq. metre
35.	Wheat	500/= per sq. metre
36.	Cashew nuts	15,000/= per tree mature
37.	Pepper (red)	200/= per plant
38.	Sisal	10,000/= per stool
39.	Greens (dodo, etc)	500/= per sq. metre
40.	Lemon grass	1,000/= per stand
41.	Pumpkins	5,000/= per stool
42.	Okra	300/= per plant
43.	Tobacco	1,000/= per plant
44.	Cotton	300/= per sq. metre

45.	Vanilla	20,000/= per plant
46.	Mulberry tree	1,000/= per plant
47.	Cauliflower	200/= per plant
48.	Guard plants	5,000/= per stool
49.	Ginger plants	300/= per plant
50.	Binzari	1,000/= per plant
51.	Cinnamon tree	60,000/= per tree
52.	Garlic (Tungulu)	3,000/= per sq. metre
(c)	TIMBER	
53	Eucaplytus	120,000/= per timber size 50,000/= per tree medium size 5,000/= per tree pole/building type
54	Cypress	90,000/= per tree timber size 40,000/= per tree medium 15,000/= per tree building size
55	Muvule/Mahogany	250,000/= per timber size 40,000/= per tree medium 30,000/= per tree young/building type
56	Shade/Bush trees	20,000/= per tree
57.	Palm tree	20,000/= per tree
58.	Tamarind tree	45,000/= per tree

- | | | |
|-----|-------------------|--------------------------------------|
| 59. | Sheanut tree | 45,000/ |
| 60. | Bark cloth tree | 20,000/= per tree |
| 61. | Ornamental plants | 200/= per sq. metre (spreading type) |

(d) BUILDING (TEMPORARY TYPES)

- | | | |
|-----|---|-----------------------------|
| 62. | Beehives | 15,000/= per hive |
| 63. | Houses: | |
| | (a) Mud and wattle
(Grass thatched) | 10,000/= per m ³ |
| | (b) Tins roof | 12,000/= per m ³ |
| | (c) Iron sheets roof | 25,000/= per m ³ |
| 64. | Pit latrines | |
| | (a) Mud and wattle
(grass thatched) | 120,000/= |
| | (b) Bricks walls plastered
and cemented floor | 200,000/= |
| 65. | Semi-permanent buildings: | |
| | (a) Thatched roof
Mud block/bricks plastered,
Earth floor | 20,000/= |
| | (b) Iron sheets/tins roof,
earth floor | 25,000/= |
| | (c) Iron sheets/tins roof,
cemented floor | 60,000/= |

- 66. Graves
 - (a) Uncemented 75,000/= per grave
 - (b) Cemented 200,000/= per grave
 - (c) Marble 500,000/= per grave

- 67. Granaries 50,000/= per granary

- 68. Quarry
 - (a) Murrum 1,000/= per cubic metre
 - (b) Stones/rocks 15,000/= per cubic metre

(e) **OFFICE OF THE CHIEF GOVERNMENT VALUER WILL REMAIN RESPONSIBLE FOR DETERMINING THE VALUES OF THE ITEMS BELOW:**

- 69. Land
- 70. Permanent Buildings
- 71. V I P latrines
- 72. Plate and cup racks
- 73. Bath enclosures/shelters
- 74. Animal pens
- 75. Fish ponds
- 76. Fences
- 77. Statutory disturbance allowances:
 - (a) evacuation within 3 months 30% of compensation value
 - (b) evacuation in 6 months 15% of compensation value