

# **ENVIROMENTAL IMPACT STATEMENT FOR THE REDEVELOPMENT OF KALIRO SUBSTATION**

**LOCATED AT NAKIYANJA ZONE, KALIRO TOWN COUNCIL,  
KALIRO DISTRICT**

**Submitted by:**

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## **Abbreviations and Acronyms**

DEO	District Environment Officer
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ERA	Electricity Regulatory Authority
KTC	Kaliro Town Council
KDLG	Kaliro District Local Government
NEA	National Environment Act
NEMA	National Environment Management Authority
NWSC	National Water and Sewerage Corporation
OHS	Occupational Health and Safety
PB	Project Brief
PPE	Personnel Protective Equipment
UEB	Uganda Electricity Board
UEDCL	Uganda Electricity Distribution Company Limited
UETCL	Uganda Electricity Transmission Company Ltd

## EXECUTIVE SUMMARY

Redevelopment of the Kaliro substation has become given the excessive load growth for the Iganga substation which also has outlets to Iganga Town, Mbale and Busia, Tororo and Bugiri. There is also increasing demand from Kaliro district and the existing supply is unable to sustain demand from small scale industries mushrooming in the area, and to address demands from the social services sector, including health and educational institutions. Redevelopment of this substation will greatly boost rural electrification efforts, improve social services delivery including health and education, facilitate value addition to agricultural products and attract more industrial investments to the area.

UMEME Ltd plans to install a 2.5 MVA transformer, with an addition 2.5MVA planned for the second phase. Upgrade of overhead cables linking Iganga to this substation has already been undertaken from the previous 11 KV to 33 KV. The old transformer installations were earlier decommissioned by the defunct UEB.

The existing Iganga – Kaliro network registers voltage drop of 40% and losses of up to 1.2MVA. This development is in line with UMEME Ltd objectives, that include: Stabilizing the management of the utility; Investing capital in the critical areas of the network to improve quality of supply; Reduction of non technical losses and arrears; Systematically transforming the business by introducing modern technology and world best practices to achieve our vision of becoming the leading East African Distributor of electricity by any measure, by 2010.

The redevelopment will involve civil works, that is cut and fill activities, and compacting works; Construction of a new plinth, substation plant house, access road, guard house, toilet facility and perimeter fence; Electrical works including installation of new switch gear and transformer and their commissioning.

Evaluation of impacts (Chapter 7) reveals that the Kaliro Substation project may result in adverse environmental impacts on human and on the natural environment if not mitigated.

The likely adverse impacts have been evaluated based on the project implementation phases including construction, commissioning, operation and maintenance.

The construction phase (Civil works) impacts include:

- Occupational health and safety of the workers;
- Dust and noise from construction equipment
- Impact on area aesthetics, with construction vehicles and materials;
- Generation of sanitary and other solid wastes

Impacts from the operation and maintenance phase:

- Occupational health and safety hazards, including electrocution during plant commissioning, operations and maintenance;
- Risk of fires due to ineffectiveness of electrical protective systems;
- Noise generation from the substation affecting neighbouring residents;
- Oil spillage that could contaminate soils and ground water;
- Safety of workers and neighbouring community;
- Exposure to electromagnetic fields;
- Run-of water from the site to immediate neighbourhood;
- Impact on area aesthetics, given the neighbourhood land use.

These impacts can be minimised or eliminated with implementation of proposed mitigation measures and adherence to the environmental management plan by UMEME Ltd.

Key mitigation measures include the following:

- Conduct induction training for contractor construction workers, drivers and employees on safety at work;
- Undertaking proper landscaping of the site to minimize run-off and soil erosion;
- Liaise with Local Authorities and lead agencies, and sensitise neighbouring residents and developers to ensure no conflicts and incidents arise during development and operational phases;
- Provide electrical equipment protection and undertake tests to ensure their proper function and appropriate isolation during construction;
- Ensure UMEME Ltd safety standards are enforced through site development, operation and maintenance phase, including the use of appropriate PPE, and signage at the plant;
- Ensure the substation is well isolated from the neighbourhood with a wall fence, and 24 hour security and surveillance provided by a reputable surety firm;
- Putting in place an adequate emergency fire fighting system at the site, and liaising with other Fire Protection agencies in case of emergencies;
- Undertake to improve area aesthetics, including emphasising underground cabling, tree planting along Iganga – Kaliro road, and painting of the substation wall to blend with the environment.

### **Recommendations**

The EIA team recommends that the National Environment Management Authority approves redevelopment of the Kaliro substation. UMEME Ltd is committed to implementation of the developed environmental management and monitoring plan

In case of any other development not addressed in this EIS, UMEME Ltd will carry out an environmental assessment or audit and address arising environmental impacts immediately.

Regular environmental audits of the facility should be carried out at least once every year preferably by a competent environmental auditor (s) and reports submitted to NEMA for review and ascertain compliance with terms of approval.

## 1.0 BACKGROUND

### 1.1 Introduction

UMEME Ltd holds a concession to lease and operate the UEDCL distribution infrastructure and to supply retail electricity. The concession applies to the Authorised Territory which is the area covering a 1.0 km radius around the existing UEDCL infrastructure (33kv, 11kv and LV reticulation networks) and extends throughout the country.

UMEME Ltd intends to redevelop the Kaliro substation located at Kaliro Town, 34 km from Iganga Town. UMEME will introduce one 2.5 MVA transformer, with an addition 2.5MVA planned for the second phase. This has become necessary given the excessive load growth for the Iganga substation which also has outlets to Iganga Town, Mbale and Busia, Tororo and Bugiri. There is also increasing demand from Kaliro district and the existing supply unable to sustain demand from small scale industries mushrooming in the area.

Overhead cables linking Iganga to this substation have already been upgraded from the previous 11 KV to 33 KV. The old transformer installations were earlier decommissioned by the defunct UEB.

This development is in line with UMEME Ltd objectives, that include: Stabilizing the management of the utility; Investing capital in the critical areas of the network to improve quality of supply; Reduction of non technical losses and arrears; Systematically transforming the business by introducing modern technology and world best practices to achieve our vision of becoming the leading East African Distributor of electricity by any measure, by 2010.

Redevelopment of this substation will greatly boost rural electrification efforts, improve social services delivery including health and education, facilitate value addition to agricultural products and attract more industrial investments to the area.

### 1.2 Project description

The size of the substation site is 61 X 61 m for which tenure exists with UEDCL. The site development plans have approval from the Kaliro Town Council. Proposed works will involve civil and electrical works, and include;

- General grading and fill to raise the area to house the transformer plinth, cable ducts and plant house and filling the whole site with 150mm thick layer of compacted murrum, 25mm layer of chippings in areas with electrical installations and walkways. Grass will be planted on sections of the site without installations;
- Erection of the DC plinth for a 4 ton transformer, with has provision for retaining all the oil from the transformer;
- Erection of a plant house;
- Construction of an access road from the main road (Iganga- Kaliro) to the substation, and within the station, and parking area for service vehicles;
- Construction of a perimeter fence around the substation, steel gate and guard house;
- Construction of a one stance ventilated improved pit latrine;
- Provision and construction of the substation grounding (earthing) system.

Other works will include:

- Proper earthing of all necessary points in the substation to the earthmat;
- The electrical wiring of the Plant house;

- Installation of lights and power points inside the Plant House;
- Installation of perimeter lighting in the substation Yard;
- Provision, installation, wiring and commissioning of all switchgear and appropriate protection schemes, including those of the Power Transformers;
- Installation of metering required on the Power Transformers and the 11 kV feeders (Elster A 1700 meters).

### 1.3 Purpose of this EIA

The National Environment Act CAP 153 introduced the requirement for an Environmental Impact Statement into the Uganda Laws. Section 19 (3) of the National Environment Act, CAP 153 requires that all projects or policies that may, are likely to or will have significant impacts on the environment be subjected to EIA so that adverse impacts can be eliminated or mitigated. The third Schedule of this act lists development of electrical infrastructure in section 10, including electrical power substations, as projects for which an EIA is mandatory.

### 1.4 Objective of the EIA study

The objective of the EIA study is:

- To identify all likely positive and negative environmental impacts due to the proposed redevelopment of Kaliro substation;
- To identify and evaluate all significant negative environmental impacts, and propose appropriate mitigation measures for the attention of the developer/UMEME Ltd, for incorporation into the construction and operational phases;
- To compile an environmental impact statement report including an environmental management plan for all aspects of the proposed redevelopment of Kaliro substation for submission to NEMA for consideration for approval.

### 1.5 Methodology for undertaking EIA

The EIA team used a number of techniques and methods at every stage of data gathering and information synthesis. However, the techniques and methods varied from one expert to another (social and standard methods). These techniques and methods include and are not limited to literature review, stakeholder consultations, onsite observation and specialist studies and analyses. Some of these methods are further described below.

**Review of relevant literature-**Literature was reviewed to obtain background and secondary baseline information on the proposed project and the subject site, the regulatory and institutional context relevant to the project, and the energy sector in Uganda. All documents referred to are given in the section on references. UMEME Ltd provided the project development proposal to which the EIA Team made reference. The project schematic drawings showing proposed civil and electrical works, and spatial relationship with the neighbourhood land use were also referred to.

**Consultations with stakeholders-** Consultative meetings were held with various stakeholders and regulatory institutions (see chapter 6) to facilitate public participation in the activities of proposed project as recommended by the National Environmental Act, CAP 153, EIA Regulations 1998, and Conduct of Environmental Practitioners Regulations, 2001 and Guidelines for EIA in Uganda. The aim of these meetings was to identify and take note of environmental concerns and views of all the stakeholders at an early stage so that their proposed mitigations are incorporated in the final implementation plan of the project.

**Other quantitative and qualitative methods applied -** Qualitative methods such as direct observation and photography were used to obtain information on the subject site and the

neighbourhood. Quantitative techniques were applied in the assessment of the floral and fauna status of the subject site and surroundings. Hydro-geological investigations were undertaken to establish soil profile and site hydrological regime, and to develop a civil solution prior to site development.

### **1.6 The EIA Team**

This EIA was undertaken by a team of Certified EIA Practitioners whose names and designations are given below;

Otim Moses: Team Leader/Environmental Systems Analysis

Kityo Peter: Natural Resources Management Specialist

Nkuutu David: Botanist

Kahubire Edith: Sociologist

These were supported by the following specialists:

Eng. Jude Kidega (B. Sc. Electrical Engineering): High Voltage Engineer

Eng. James Semuwemba: M. Sc. (Environmental Engineering) – Civil Engineer

Ms. Kate Zziwa: Hydrologist

Ms. Sheba Ndagire: Ecosystems and Human health Specialist

### **1.7 Structure of the EIS**

The structure of this report is in conformity with NEMA and the Energy Sector EIA guidelines, as well as World Bank standards. The main sections are as outlined below.

The Executive Summary provides key findings of the study including the likely project impacts, their mitigation, and study recommendations for site development.

Chapter 1 provides the project background, justification, and the methodology used for this EIA study.

Chapter 2 presents the legal and institutional framework relating to electrical infrastructure development particularly power substation projects;

Chapter 3 provides the site baseline social and environmental conditions;

Chapter 4 presents a detailed description of the proposed switch station upgrading to a substation, and a civil solution for site development;

Chapter 5 Discusses project need and alternatives;

Chapter 6 presents concerns of the public and stakeholders consulted and how these have been addressed in this EIS;

Chapter 7 presents an analysis of project impacts and their mitigation;

Chapter 8 presents an environmental management and monitoring plan to be implemented by UMEME ltd;

Chapter 9 provides major conclusions and recommendations of the EIA study;

The report provides pages with references of literature utilised in for this report, and appendices that are referred to in the above chapters.

## **2.0 REGULATORY CONTEXT**

Environmental Impact Assessment is a legal requirement and should be carried out for all proposed developments that are likely to have significant environmental impacts. EIAs for development of electrical installations, including substations is mandatory, as listed in the third schedule of the National Environment Act Cap153 so that any negative impacts can be minimised or eliminated and the positive ones enhanced. The policy, laws and regulations that were considered during the assessment exercise are reviewed hereafter.

### **2.1 National policies**

#### **2.1.1 The National Environment Policy, 1994**

The overall goal of National Environment Management Policy, 1994 is to promote intergenerational equity and sustainable development that maintains and enhances environmental quality and resources periodically to meet human needs of the present generation without compromising ability of future generations meeting their own.

#### **2.1.2 The National Energy Policy, 2002**

The policy goal in the energy sector is to meet the energy needs of the Ugandan population for social and economic development in an environmentally sustainable manner. Specifically, the energy policy seeks to meet the following broad objectives:

- To establish the availability, potential and demand of the various energy resources in the country;
- To increase access to modern, affordable and reliable energy services;
- To improve energy governance and administration;
- To stimulate economic development;
- To manage energy-related environmental impacts.

In pursuit of these objectives, the government will ensure that environmental considerations are given priority by energy suppliers and users to protect the environment and will put in place a monitoring mechanism to evaluate compliance with established environmental protection guidelines.

#### **2.1.3 The Investment Policy/Code**

Development of electrical installations being an investment, is subject to the provisions of the Uganda Investment Policy/ code thus it is a mandatory requirement under Section 19s (2) (d), for every investment licensee to take necessary steps to ensure that the operations of his/her business unit do not cause injury to the ecology or environment.

#### **2.1.4 The Land Use Policy, 2004**

In support of the national objectives on poverty eradication and economic growth, while at the same time ensuring sustainable utilisation of natural resources including land and water, the National Land Use Policy's main goal is 'to achieve sustainable and equitable social and economic development through land utilisation in Uganda'.

The specific goals of the Policy are to:

- Adopt improved agriculture and other land use systems that will provide lasting benefits for Uganda, and to alleviate adverse environmental affects at local national, regional and global levels;
- Promote land use activities that ensure sustainable utilisation of natural resources for national socio-economic development;
- Ensure planned, environmentally friendly and well-distributed human settlements for both rural and urban areas; and

- Update and harmonise all land use related laws, and policies and strengthen institutional capacity at all levels of Government.

The Policy emphasises among others environmental friendly practises, community based participatory planning; gender and land ownership.

## **2.2 National legislation and regulations**

### **2.2.1 The Constitution, 1995**

The Constitution in its National Objectives and Directive Principles of State Policy, Objective XIII provides for the protection of natural resources. It provides that “the State shall protect important natural resources, including land, water, wetlands, minerals, oil, fauna and flora on behalf of the people of Uganda”.

Objective XXVII (i) obliges the State to promote sustainable development and public awareness of the need to manage land, air and water resources in a balanced and sustainable manner for the present and future generations.

Paragraph (ii) of that objective goes ahead to state that the State shall take all possible measures to prevent or minimize damage and destruction to land, air and water resources resulting from pollution or other causes.

Article 39 enshrines the right of every Ugandan to a clean and healthy environment. Article 237(2)(b) of the Constitution provides that notwithstanding clause (1) of Article 237 which provides that land in Uganda belongs to the citizens of Uganda to vest in them according to the land tenure systems provided for in the Constitution, Government or a local government shall hold in trust for the people and protect natural lakes, rivers, wetlands, forest reserves, game reserves national parks and any land to be reserved for ecological and tourism purposes for the common good of all citizens.

### **2.2.2 The National Environment Act Cap 153 and Regulations**

This provides for a developer of a project described in the third schedule to this statute to submit a project brief to the lead agency, in the prescribed form and giving the prescribed information. Where a project/ an activity may have, is likely to have or will have significant impact on the environment, an environmental impact study should be conducted.

### **2.2.3 The Environmental Impact Assessment Regulation, 1998**

The Environmental Impact Assessment Regulations, 1998 (Statutory Instruments No. 13/1998), dictates that an EIA shall be conducted in accordance with terms of reference developed by the developer in consultation with the Authority. As per section 12, public participation is a requirement. In the course of this study, various stakeholders have been informed of the project concept, and widely consulted for their views on the effects and benefits of this undertaking. The list of persons and institutions consulted is provided in appendix 2. The approved Terms of Reference for this EIA area also attached.

### **2.2.4 The National Environment (Standards for Discharge of effluent into Water or on Land) Regulations, 1999**

Considering the likelihood of waste oil generation from the substation facility, this regulation will have to be taken into consideration in the development of this site. This regulation provides for standards (maximum permissible limits) for effluent or waste water before discharge into water or on land, a general obligation to mitigate pollution, and a duty to keep records of amount of waste generated and parameters of the discharges.

### **2.2.5 The National Environment (Waste Management) Regulations 1999**

Section 5 provides for a person who owns or controls a facility or premises, which generate waste, to minimize the waste generated by adopting cleaner production methods. Subsection 1 (b) I identify and eliminate potential negative impacts of the product/waste. Subsection (c) Incorporate environmental concerns in the design and disposal of a product. Section 12 provides that an industry shall not discharge or dispose off waste of any state into the environment, unless the waste has been treated in a treatment facility and in a manner approved by the lead agency in consultation with the authority.

### **2.2.6 The National Environment (Noise Standard and Control) Regulations (2002)**

Noise generation from the substation will be from the transformer bus bars and during equipment installing and maintenance. This can have an impact on neighbouring communities, particularly the School and residences.

Section 7(1) states that “No person shall emit or engage in any activity that emits or likely to emit noise above a maximum permissible level specified in Section 6 and Schedule 1 of these Regulations, unless permitted to do so by these Regulations.

Section 8(1) – provides for the duty to control noise. It shall be the duty of the owner or occupier of a facility or premise or machinery to use the best practicable means of ensuring that the emission of noise from those premises does not exceed the standards and limitations set in these regulations. In compliance with this requirement, UMEME Ltd will have in place equipment meeting the noise standards.

### **2.2.7 The Electricity Act, 1999**

The Electricity Act, 1999 provides for the establishment of the Electricity Regulatory Authority (ERA) whose functions include: issuing licenses for the generation, transmission, distribution or sale of electricity; controlling activities in the electricity sector; liberalizing and bringing competition in the electricity sector; This Act replaced the Electricity Act, 1964 and provides for a successor Company to the Uganda Electricity Board (UEB).

Section 30 of the Electricity Act requires that before a license is issued the developer shall provide NEMA the description of the impact of the project on electricity supply, socio-economics, cultural heritage, the environment, natural resources and wildlife, hence this EIA study.

### **2.2.8 The Land Act, 1998**

The Land Act, 1998 provides for the ownership and management of land. It provides for four different types of land tenure (Customary, Leasehold, Mailo and Freehold) and the procedure for applying for grant of any of the tenures. The Act inter alia provides that the construction of electricity transmission and distribution lines, construction of dams and hydropower plants are public works and any person authorized 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.

According to Section 43 of the Land Act, Government or Local Government may acquire land in accordance with the provisions of the Article 26 and Clause (2) of Article 237 of the Constitution.

Section 44 of the Land Act 1998 states that a person who owns land shall manage and utilize the land in accordance with the Forest Act, the Mining Act, the National Environment Statute, 1995, the Water Statute 1995, the Uganda Wildlife Statute 1996 and any other law.

### **2.2.9 The local Government Act, 1997**

The Local Government Act, 1997 provides for decentralization and devolution of Government functions, powers and services from the central to local governments and sets up the political and administrative functions of local governments. The local governments are responsible for the protection of the environment at the district level. This therefore, implies that local governments shall be consulted on projects to be located within their jurisdiction and on matters that affect their environment. The proposed land use by UMEME Ltd has approval from Kaliro Town Council.

### **2.2.10 The Town and Country Planning Act Cap. 30**

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 installations and development in relation to any land. Any placing of new poles for transmission and distribution of electricity and construction of substations must comply with the provisions of this Act.

### **2.2.11 The Roads Act, 1964**

The Roads Act of 1964 is a critical piece of legislation with respect to the construction of access roads to energy provision facilities. It defines a road reserve as that area bounded by imaginary lines parallel to and not more than fifty feet distant from the centerline of any road. The Act is silent on whether such land is "taken" for the state, but states that no person shall erect any building or plant trees or grow permanent crops within a road reserve. However, it allows the roads authorities to dig and take materials from the road reserve for the construction and maintenance of roads. The road authority is required to give written notice to the illegal occupier of the land on which prohibited activities have been carried out. The office of the District Engineer Kaliro District Local Government has been consulted about the proposed developments.

### **2.2.12 The Water Act Cap 152**

Under Section 100 of the Water Act CAP 153, all right to investigate, control, protect and manage water in Uganda is vested in the Government and in section 34 it makes it an offence to pollute or cause risk of water pollution. The designs for the substation provide measures to protect ground and surface run-off water from pollution.

### **2.2.13 The Investment Code of 1991**

In Section 19s (2)(d), the code makes it an implied condition of every investment license 'to take necessary steps to ensure that the operation of his business enterprise do not cause injury to the ecology or environment."

### **2.2.14 The Penal Code Act CAP. 106**

In section 171, 172, 173, it creates offence against pollution and adulteration of air, water as well as noise pollution.

### **2.2.15 The Factories Act, 2000**

This Act provides for the health, safety and welfare of persons employed in the factories and other places.

In the execution of this project, the above regulations will be put under consideration and observed for the smooth implementation of the development.

## **2.3 Institutional linkages**

### **2.3.1 Ministry of Water and Environment**

The ministry is the institution responsible for the formulation of policies that govern environmental management in Uganda hence responsible for environmental issues in the country.

### **2.3.2 National Environment Management Authority**

This is the principal agency in Uganda responsible for the management of the environment and is charged with the coordination, supervision and monitoring of all activities related to environmental management.

### **2.3.3 Kaliro District Local Government**

The District Political head is the Chairman LC5, and the executive head is the Chief Administrative Officer (CAO), who is assisted by a Council that acts as the legislative body. All departmental heads are answerable to him and he's assisted by the Deputy CAO. The officials who have been consulted in the course of this EIA include the Chief Administrative Officer, the District Planner, The District Engineer, the Director Natural Resources and the District Environment Officer.

### **2.3.4 The Electricity Regulatory Authority (ERA)**

ERA is a corporate body established to oversee implementation of the Electricity Act 1999. Under this Act, ERA is mandated to review proposed investments in the energy sector and guide the promoters through implementation. This includes enforcing the requirements under the Electricity Act to ensure compliance with regulations.

The Electricity Act 1999 repealed the Electricity Act CAP 135 and the Uganda Electricity Board (Special Provisions) Act CAP 136. Following liberalization of the energy sector, The Electricity Transmission Company (UETCL) and Uganda Electricity Distribution Company (UEDCL) were formed. The assets of UEDCL are leased by UMEME Ltd for a 20 year concession period. UMEME Ltd purchases power from UETCL.

### **2.3.5 Ministry of Works and Transport**

The Roads Act 1964 is a critical piece of legislation with respect to the construction of access roads to energy provision facilities. It defines a road reserve as that area bounded by imaginary lines parallel to and not more than fifty feet distant from the centre line of any road. The size of the substation land is 61 x 61 m for which tenure exists with UEDCL. There will be no need for the substation to erect structures in the road reserves.

### **2.3.6 The Ministry of Energy and Mineral Development**

The Mission of the Ministry of Energy is to establish, promote the development, strategically manage and safeguard the rational and sustainable exploitation and utilization of energy and mineral resources for social and economic development. The Energy Resources department in this ministry has the following objectives:

- To create an enabling environment in order to attract investment in the development, provision and utilization of energy resources;
- To ensure the rational development of sustainable and efficient use of energy resources;
- To promote, facilitate and harmonize standards and regulations concerned with energy;
- To ensure compliance with set standards, laws and policies, as well as competitiveness in the energy sector;
- To strategically manage energy resources in the national interest;
- To promote export of energy resources; and
- To facilitate the development of suitable renewable energy resources for use in Uganda.

### **3.0 BASELINE SOCIAL AND ENVIRONMENTAL CONDITIONS**

#### **3.1 Project site setting**

Kaliro District borders Kamuli District in the west, Iganga in the south, in the north-east it adjoins Pallisa District and in the north, Kaliro is bordered by Lake Nakuwa. The administration headquarter is located in Kaliro Town, 34 kilometres from Iganga Town.

The project area is located along Iganga – Kaliro road in Nakiyanja Zone, within Kaliro Town Council. The site measures 61 x 61 m, and previously contained a substation that was run by UEB up until the 1970's. The infrastructure then included a transformer, a plant house, and a plinth, all of which were decommissioned.

Figure 3.1 presents pictures of the site conditions prior to and after reclaiming by UMEME Ltd.



**Figure 3.1: The substation site: Plate a – Plant house at the site before site clearance; Plate b – proposed access road, security house and western neighbourhood; plate c - the site overgrown with bush and southern neighbourhood prior to clearance; plate d – the cleared site and southern neighbourhood; plate e - the Iganga - Kaliro road and southern neighbourhood; plate f – the eastern neighbourhood showing Kaliro College S.S premises and proposed boundary.**

### **3.2 Biophysical conditions**

#### **3.2.1 Geology**

Kaliro district is underlain by main two types of rock system: the Cainozoic and Pre-Cambrian rocks.

##### ***Cainozoic Rock System***

Cainozoic rock system is basically Pleistocene to Recent rock material composed of sediments, alluvium, black soils, and moraines. This system is limited to the fringes of Lake Kyoga to the north of the District and wetland areas.

##### ***Pre-Cambrian Rock System***

The rest of the District area is underlain with Pre-Cambrian rocks system. It is mainly wholly granitized or high to medium grade metamorphic formations, composed of undifferentiated gneisses including elements of partly granitized and metamorphosed formations. This is generally a zone of intrusive granite and granitoid gneisses.

#### **3.2.2 Soils**

The soils are predominantly dark brown clays, underlain by gneiss. The district generally has shallow sandy loams of medium to low fertility. Site geophysical mapping has been undertaken to establish soil profile (figure 3.2) and ground water levels. Ground water can be encountered at the site at about 20m (see appendix 6).

**Figure 3.2:** Stratigraphy at proposed site

#### **3.2.3 Drainage**

Kaliro district lies in the Lake Kyoga catchment, and drains northwards. The western and eastern part of the district comprises mainly of wetlands. The rest of the district is characterised by plains with wide upgraded major valleys and low rounded interfluves. Major valleys often contain papyrus swamps and minor valleys seasonal streams. Local drainage from Kaliro Town is to the south west then north eastwards into the Mpologoma River.

Kaliro district has only one lake to the north of the district, and this is Lake Nakuwa which is a lake of international importance as it was declared a Ramsar site. This lake is located in the heart of the Lake Kyoga wetland system and forms a mixture of satellite lakes and extensive marshes of papyrus broken into floating sudd. This is the only wetland where sudd are found which move back and forth by force of the Mpologoma River and back-surge of River Nile. The lakes wetland system supports endangered and rare endemic species of fish (including endangered Haplochromine species), reptiles and birds (Papyrus Yellow Warbler, Shoebill and the vulnerable Marsh Widowbird) and is important for maintaining biological diversity of the region. Other swamps in the district are Lumbuye, Naigombwa, and Nakiyanja.

#### **3.2.4 Vegetation**

The predominant vegetation cover in the district is the forest/Savannah mosaic constituted of a mixture of forest remnants and savannah trees with grass and shrubs. Much of it is secondary vegetation that has succeeded the original forest cover as a result of farming, timber and fuel harvesting and other forms of land use that take place.

#### **3.2.5 Site flora and fauna**

The site is situated in a relatively old habited area, with current land use including residential, commercial and institutional premises. The area vegetation has been modified over time, and is composed of scattered planted trees and a strip of wetland to the south.

## Flora

To study the vegetation structure and composition at the site and its neighbourhood, a complete enumeration of the trees was carried out while the herbaceous plants were sampled in circular plots of 2 meter radius at intervals of 20 meters.

Voucher specimen of every species were collected and given a unique number and compared with the specimens at the National Herbarium at Makerere University. Details of specimen that were not identified in the field were recorded by reference to the specimen number to help in identification at the Herbarium.

A species list for the site was compiled to show the relative abundances using the encounter rate. The respective life forms and families are presented in Appendix 3.

A total of 34 species were recorded during this assessment; 5 trees, 3 shrubs and 2 lianas and 26 herbaceous plants species were recorded. All 36 species recorded belonged to 19 families. Among the common species encountered are *Cynodon dactylon*, *Commelina benghalensis*, *Amaranthus dubius* and *Ageratum conyzoides*. The commonest families were Poaceae and Euphorbiaceae and Asteraceae with seven, five and four species respectively. Most of the species encountered are human induced under disturbed environment and habited environment.



**Figure 3.3: a - cleared substation site and b – vegetation in the neighbouring habited area**

The number of tree species recorded and their density was very low with a total of 2 big trees on the site, 7 saplings and 5 trees in the adjacent environment that were planted as shade and fruit trees within the compound of the neighbouring school and these included *Mangifera indica*, *Cassia siamea*, *Ficus sycamoros*, *Markhamia lutea*, *Carica papaya*, *Thevetia peruviana* and *Hibiscus fuscus*. There were no unique species of conservation importance recorded in the area. This implies that the project will not have a direct impact on the change of land use towards the vegetation. The area had previously been built up and paved for utilization as a sub-station that was vandalized in the 70s.

## Fauna

The project site is dominated by herbaceous plants in a habited environment; this limits the habitats for

fauna. Therefore no fauna of significant importance was recorded at the project site at the time of assessment. No higher animals were observed during the study, although two bird species were heard in the near by trees these were a Glossy blue sterling and a bulbul and insects. There was no indication of significant animal, insect and bird species in the project area.

### **3.2.6 Climate**

The climatic data of the area is based on information contained in the Kaliro district development plan.

The rainfall is a climatic factor of the greatest economic significance for the district. The district experiences a bimodal type of rainfall with peaks in March-June as well as August –November, with the March to June peak as the major one. The average annual temperatures in most areas of the district range from 19<sup>0</sup> C -25<sup>0</sup> C Celsius

### **3.3 Socio-economic and cultural conditions**

The aim of this section is to present the socio-economic situation in the locality of the proposed Substation. It begins with the current socio-economic setting and the potential benefits of the project. Then it raises the concern of the stakeholders in terms of the livelihoods and employment, possible impacts on public health, safety and security.

#### **3.3.1 Administrative structure**

Administratively the district has one County, 5 sub-counties (Bumanya, Gadumire, Namugongo, Namwiwa and Nawaikoke), one self-accounting Town Council, Kaliro. The district comprises of 34 parishes and 290 villages.

#### **3.3.2 Population**

According to the 2002 census, Kaliro district population (formerly Bulamogi county) is about 154,667 people with females at 51% and males at 49%, the average household size being 5.3. Some of the fast growing rural centres include Bulumba, Nawaikoke, and Bumanya.

Kaliro Town attracts more people during the day because of the services provided which include employment and educational institutions.

#### **3.3.3 Land tenure and land use**

79% of the population in the district own land through the customary land tenure system. Other forms of tenure include freehold and leasehold. Tenure for the site for this substation is held by UEDCL.

A mix of different forms of land use characterizes the project area. They range from:

- A secondary school to the east,
- Commercial and residential areas to the west, south and north
- Iganga-Kaliro road to the west.

In principle there are no existing land uses (built, heritage, recreational area) that may be displaced/converted due to redevelopment of the substation. However impacts on existing land uses have to be looked into and mitigated. This is further discussed in chapter 6 and 7. The project activities will be restricted within the 61m X 61m plot.

#### **3.3.4 Social Services and Infrastructure**

Kaliro district largely depends on boreholes as the main source of reliable portable water. The areas around Lakes in the North and Northeast have salty water. There are a total of 311 protected water sources in the district. Kaliro Town Council has piped water supply but the coverage is still very limited for this unusually vast Town Council. Its supply is also erratic being dependent on electricity supply.

The infant mortality rate for Kaliro is 118 deaths per 1000 live births (2002 population Census), which is higher than the national average of 88 per 1000 live births (UDHS 2000 – 2001). Geographical access to health facilities (Parishes with Health Units) is 46% and thus also higher than the national average of 42.7% (Health sector strategic plan 2001 – 2005). Recent developments in the district have led to the establishment of a new health centre with facilities surgery. This health unit will require an unwavering supply of electricity if it is to run efficiently enough to meet the district's health targets.

Kaliro District is linked to other districts by roads, water and railway system, however, the major means of transport is by road. The district also has operational Post office services and Uganda Telecom, Mobile Telephone Network and Celtel telecommunications services.

### **3.3.5 Economic activities and power requirement**

In terms of economic activity, most of the people are self employed constituting 18.375, followed by household work at 14%. Very few are paid up employees. Crops grown include cotton, coffee, maize and beans among others.

Kaliro district lies in the Iganga UMEME District, and is fed by an 11 KV line from Iganga substation. This network covers Kaliro Town, Nambale, Busembatya and Namutumba. Kaliro Town is centrally located to supply the growth centres of Bumanya, Namukoge, Nawaikoke, Gadumire and Namwiwa, as a launch pad for rural electrification (see figure 3.4 for existing network, and 3.5 for rural growth centres).

There is a high demand for electricity for small scale industries, including ginneries, maize mill, coffee processing machines, water supply, schools, health facilities and households, but the supply and distribution network remains deficient. Kaliro town has only 1 50 KV transformer and this cannot sustain even lighting requirements once maize mills and on line.

Recent developments in the district that would require an increased and steady power supply include a Sugar Factory at Kasokwe, a rice project at Namukoge by Spenco, a hospital at Bumanya and Maize mills. Improved power supply is seen as key to industrial development, improved social services, attraction of investors and modernisation in the district.

**Figure 3.4: Existing UMEME Ltd network, Iganga - Kaliro**

**Figure 3.5: Rural growth centres and road network for Iganga – Kaliro area**

## **CHAPTER 4: PROJECT DESCRIPTION**

### **4.1 Introduction**

The need for redevelopment of Kaliro Substation has arisen due to the increased load growth in Iganga UMEME District, hence the need to relieve this substation 11 KV loads. The proposed redevelopment of Kaliro substation is characterized and described systematically in three phases:

- Decommissioning Phase;
- Construction phase, and
- Operation phase.

The decommissioning phase was already undertaken by UEB and is briefly discussed here.

### **4.2 Decommissioning phase**

The decommissioning phase involved the following;

- Diversion of all loads away from Kaliro substation to Iganga;
- Decommissioning of existing switchgear and equipment, and the decommissioned cables, switchgear, hardware, equipment and components booked back into the stores (though some equipment had already been vandalised);

Recent decommissioning activities by UMEME Ltd have included;

- Demolishing plant house. The existing one would be inadequate to house planned equipment;
- Demolition of plinth, and modification to allow for spilled and waste oil retention;
- Clearing of vegetation at the site. The area had become bushy having been abandoned by UEB.

### **4.3 Construction phase**

Proposed works will involve civil and electrical works, and include;

- Relocation of access to the neighbouring Kaliro College S.S, and new access road to the substation;
- Site excavations in preparing a strong basement and to improve drainage at the site
- General grading and fill to raise the area to house the transformer plinth, cable ducts and plant house and filling the whole site with 150mm thick layer of compacted murrum, 25mm layer of chippings in areas with electrical installations and walkways. Grass will be planted on sections of the site without installations;
- Erection of the DC plinth for a 4 ton transformer, with has provision for retaining all the oil from the transformer;
- Construction of a plant house;
- Construction of an access road from the main road (Iganga- Kaliro) to the substation, and within the station, and parking area for service vehicles;
- Construction of a perimeter fence around the substation, steel gate and guard house;
- Construction of a one stance ventilated improved pit latrine;
- Provision and construction of the substation grounding (earthing) system.

Other works will include:

- Proper earthing of all necessary points in the substation to a new earthmat;
- The electrical wiring of the Plant house;
- Installation of lights and power points inside the Plant House;

- Installation of perimeter lighting in the substation Yard;
- Provision, installation, wiring and commissioning of all switchgear and appropriate protection schemes, including those of the Power Transformers;
- Installation of metering required on the Power Transformers and the 11 kV feeders (Elster A 1700 meters);
- Works to minimize visual impact of the substation on the neighbouring land uses including painting and tree planting;

#### **4.4 Commissioning, operation and maintenance phase**

Prior to plant commissioning, a number of tests will be undertaken to ensure site safety, limit damage to equipment and to protect the environment. Some of the test to be undertaken will include;

- Insulation resistance measurement;
- Magnetic curves;
- Primary injection;
- Master relay tests;
- Winding temperature gauge calibration;
- Buchholz relay protection
- Transformer relief valves inspection/tests;

The electrical equipment commissioning and protection measures are provided in section 7.4.

UMEME Ltd has in place an OHS policy, and operational procedures that will be enforced to ensure safety at work during operations and maintenance.

The arising environmental concerns during the operation and maintenance phase include:

- Oil spillage;
- Safety of workers and neighbouring community;
- Effectiveness of electrical protective systems;
- Exposure to electromagnetic fields;
- Electrical fires;
- Run-of water from the site to immediate neighbourhood;
- Area aesthetics, given the neighbourhood land use.

Mitigation measures for these environmental concerns have been proposed in section 7 and an environmental management and monitoring plan is section 8.

#### **4.5 Civil solution for site development**

##### **General**

The civil works associated with the redevelopment of Kaliro substation shall include but not limited to the following: (i) Site clearance and grading (ii) Excavating new foundations (iii) Platform Construction (iv) Sub-surface Drain construction (v) Pipe trench digging and drain pipe laying (vi) Access road and Service area construction. The impacts of these proposed works and their mitigation measures are discussed below.

##### **Site Clearance and Grading**

The site shall be cleared of all debris and vegetative matter prior to final levelling taking place. All waste material shall be safely disposed off to a gazetted site in an environmentally safe way.

During construction, the site shall be cleared of the top 300mm of top soil. This will then be replaced by approved layer of sub base material laid and compacted to 95% Maximum Dry Density-MDD (Mod AASHTO) in layers not exceeding 150mm. The area to be occupied by the plant house will then be raised by a further 0.3m above existing ground level to form a platform/beam. Minimum of 6 compaction tests shall be carried out on the completed platform. (Test method TMH 1).

#### **Figure 4.1: Foundation Excavation**

The following requirements shall apply to foundation excavations:

- 1) Foundation excavations shall be dug as close as possible to the required size;
- 2) Where the depth of the foundation excavation is deeper than 1,5 m, shoring shall be used;
- 3) Shoring shall be used where the soil has a tendency to cave in: for example, in sandy soils;
- 4) The bottom of all foundation excavations shall be level and cut squarely with the sides of the excavation; and
- 5) If there is loose soil in the bottom of the foundation excavation, the soil shall be moistened and compacted with a mechanical plate compactor to ensure the bottom is firm to avoid settlement.

Where compaction is required around an excavation, 300 mm layers of fill shall be added to the excavation and compacted with a mechanical plate compactor. This shall be repeated until the hole is filled up to the required level. Samples of all stone, sand and water to be used in the concrete shall be tested and approved prior to construction commencing. Cube testing shall be done on all concrete works. All plinths and bases shall have a minimum strength at 28 days of 20 MPa with a nominal stone aggregate size of 19 mm to 25 mm. All blinding and strip footings shall have minimum 28 day strength of 15 MPa. All structural concrete specials shall be designed by a structural Engineer. Any additives to the concrete shall have the approval of the Engineer.

#### **Figure 4.2: Sketch of platform**

#### **External Drainage**

This site is located in a relatively flat area and partly drains run – off from the Iganga – Kaliro paved road. An earth berm 1.5 m wide  $\times$  0.75 high shall be constructed from sub grade material. The sides shall be shaped to a gradient of 45° and compacted to a density of at least 90 % of Mod AASHTO maximum density. This berm shall lead the water away from the substation into a drainage provision to be along the Iganga – Kaliro road.

Run-off from the substation itself naturally drains to the south. The un-built up areas at the site will be covered 25mm crushed rock, and the rest planted with grass to limit run-off water (see figure 4.3).

#### **Figure 4.3: An improved Jinja substation. Note the crashed rock and grass planted to limit run-off and erosion.**

#### **Access road construction sketch**

This substation warrants surfaced roads with kerbs and channels. The access road shall consist of a 25mm crushed rock fill, onto 200 mm gravel base stabilised with 5% lime and compacted to 98% MDD, onto 200 mm gravel subs – base compacted to 98 % MDD, onto 200mm improved sub-grade compacted to 98% MDD (see figure 4.4). Where poor soils or drainage problems are encountered, it becomes economical to surface the road with a wearing surface as the long term maintenance costs will become a significant factor.

## **CHAPTER 5: DISCUSSION OF PROJECT NEED AND ALTERNATIVES**

This chapter presents the project need, and redevelopment of Kaliro substation as the preferred option to address the increased power demand in the District and other areas connected to the Iganga – Kaliro network.

### **5.1 Project need**

Power supply is key for industrial development, attraction of investments, improved social services, modernisation and poverty eradication in the region, KaliroKamuli district in particular. The existing network is overloaded and unable to sustain increasing power demands, particularly from the small scale industries. For UMEME Ltd, this is an opportunity to reduce losses, relieve the Iganga substation of 11 KV loads, an improve supply to customers.

### **5.2 The No Action alternative**

The “no action” alternative is important to ensure the consideration of the original environment without any development. In this case it will mean the site will remain vacant for alternative land use. It is important for the decision makers in considering all possibilities and taking an informed decision.

The no – action alternative will also mean sacrificing socio-economic benefits related to a steady power supply to Kaliro District, particularly for small scale industries, hospitals, schools and the service sector in the Kaliro CBD, sacrificing numerous jobs. It would also mean continued loss of interest of investors who need electric power for their proposed installations.

No action also means continued losses to UMEME Ltd. A simulated Iganga - Kaliro network shows voltage drop down of up to 40% causing UMEME Ltd losses of about 1.2MVA annually (source: UMEME Ltd, 2007).

Considering recent developments in neighbouring land use, the site will then have a negative impact on area aesthetics and security concerns for the neighbouring school and residents if left intact without any development.

The No Action alternative is thus not tenable.

### **5.3 Alternative sites and technologies**

Alternative sites and technologies have been considered by UMEME Ltd for economic and technical viability. Table 4.1 presents a summary of proposed solutions to the Iganga – Kaliro network. Option 4 to construct a new 33KV line to Kaliro and install a 2.5MVA 33KV/11KV at Kaliro is recommended. The advantage is in less costs involved, benefits to wider range of customers on the network, and relieving Iganga substation of 11KV loads.

**Table 4.1: Summary of options to redevelop the Iganga – Kaliro network**

	Proposed solution	Cost estimation (US\$)
Option 1	<ul style="list-style-type: none"> <li>• Uprate existing 33kv line upto Kaliro</li> <li>• Install 33KV/LV substation at Kaliro</li> <li>• <i>Uprate T-off to Busembatya</i></li> </ul>	<ul style="list-style-type: none"> <li>• Uprating 9okm to 33kv – 1,500,000</li> <li>• Substation cost – 200,000</li> </ul>
Option 2	<ul style="list-style-type: none"> <li>• Uprate Kaliro feeder from 11 KV line to 33KV line a total length of 167KM</li> </ul>	<ul style="list-style-type: none"> <li>• Uprating 167km of 33KV line – 2,800,000</li> <li>• Line feeder bay at Iganga – 50,000</li> </ul>
Option 3	<ul style="list-style-type: none"> <li>• Installing a 1MVA at Busembatya and uprating to 33KV the rest of the network</li> </ul>	<ul style="list-style-type: none"> <li>• Uprating of 97km of 33KV line – 1,620,000</li> <li>• Installing 1MVA at Busembatya – 200,000</li> <li>• Line feeder bay at Iganga – 50,000</li> </ul>
Option 4	<ul style="list-style-type: none"> <li>• Construction of a new 33KV line to Kaliro and install a 2.5 MVA 33KV/11KV at Kaliro</li> <li>• Open 11 KV line after T-off to Busembatya</li> </ul>	<ul style="list-style-type: none"> <li>• 32.9 Km of 33KV line – 592,200</li> <li>• Substation cost – 200,000</li> <li>• Switchgear – 90,000</li> </ul>

#### **5.4 Redevelopment of the Kaliro substation as proposed in this EIS**

The impacts of this project and mitigation measures for this alternative have been thoroughly discussed throughout this report, particularly in sections 6, 7 and 8. Positive impacts have been identified in the socio-economic area, to the environment and the national economy in general. The project would have impact on the physical environment during site preparation and development including wastes from cut and fill activities, noise, air pollution, and loss of vegetative cover through landscaping, but measures to mitigate these impacts have been recommended and UMEME Ltd is committed to implement the proposed environmental monitoring and management plan.

Particularly to note is the proposed civil solution for site development, measures to limit visual impact by emphasising underground cabling, and the safety and emergency provisions emphasized for site workers and the neighbourhood during construction, commissioning and operations of the substation.

Arrangements have been put in place to reroute power supply to the rest of the district during the installation of the electrical equipment.

## **CHAPTER 6: PUBLIC CONSULTATIONS AND DISCLOSURE**

Extensive consultations have been undertaken in the course of preparation of this EIS. Consultation with all relevant stakeholders and regulatory institutions was carried out by the EIA Team. The consultation process ensured public participation in the design and implementation of activities of the proposed redevelopment of Kaliro substation, just as is recommended by the National Environmental Act, CAP 153, the EIA Regulations 1998, and Conduct of Environmental Practitioners Regulations, 2001 and Guidelines for EIA in Uganda. The aim of these consultations was to identify and take note of environmental concerns and views of all the stakeholders at an early stage so that their proposed mitigations are incorporated in the final implementation plan of the project.

Among those consulted were Technical Staff at Kaliro District Local Government Headquarters and Kaliro Town Council, Subcounty chiefs, the management of schools in close proximity to the site, small scale industrial developers in Kaliro Town Council, and neighbours to the site. The consultation process has ensured maximum stakeholder awareness of the proposed redevelopment of the Kaliro substation, and enabled their input into this EIS. The stakeholders are aware of power shortages and increased demand in the district and would welcome efforts to address the increased need for electricity distribution. The stakeholders have been eager to contribute mitigation measures in cases of potential environmental and social impacts.

Key concerns raised include interference with activities at the substation, dust, noise generation, impact on aesthetics in the Town, traffic interference on Iganga-Kaliro road, and waste oil impacts from transformers. The stakeholders readily provided mitigation measures to these concerns and have been incorporated in chapter 7. The stakeholders' contributions to the EIA process are summarized in Table 6.1.

**Table 6.1 : Input by stakeholders consulted during the EIA study**

STAKEHOLDER	MODE OF INTERACTION	COMMENTS	ACTIONS
<p>Scovia Nakawuma Environment Officer, Kaliro District 0782098785</p>	<p>Interview</p>	<ul style="list-style-type: none"> <li>• Was on leave when the project started</li> <li>• The project was stopped because she had not reviewed the EIA from UMEME</li> <li>• She was not aware the site previously had a sub-station</li> <li>• She's concerned that this has turned into a political issue</li> <li>• Wants UMEME to first present an EIA to NEMA before she can permit work at the site</li> </ul>	<ul style="list-style-type: none"> <li>• UMEME will ensure they meet all legal requirements by submitting a terms of reference to NEMA and an EIS.</li> </ul>
<p>Kasango William, Director Natural Resources</p>	<p>Interview</p>	<ul style="list-style-type: none"> <li>• Would want many sub-stations in the district as long as they are in conformity with environmental standards set by NEMA.</li> <li>• He is concerned about people's health and safety</li> </ul>	<ul style="list-style-type: none"> <li>• UMEME Ltd committed to implement the proposed mitigation measures and Environment Management Plan in this EIS</li> <li>• UMEME Ltd also has an EHS policy applicable for all electrical installations</li> </ul>
<p>Anthony Lukwago, CAO, KDLG 0772601358</p>	<p>interview</p>	<ul style="list-style-type: none"> <li>• Wonders if this was an oversight on UMEME's part</li> <li>• Asks about the possibility of continuing with civil works while UMEME puts their EIA in place.</li> <li>• There was anxiety about UMEME taking their project away but having seen a representative from UMEME, his fears are minimised</li> </ul>	<ul style="list-style-type: none"> <li>• UMEME Ltd acknowledges it was an oversight and is doing all they can to comply with the regulations</li> <li>• UMEME requests an expedited completion of the review process to avoid incurring costs to contractors undertaking civil works, and delays to improve the Iganga – Kaliro network</li> </ul>
<p>Kagoda Elijah Chairman LC V, KDLG 0772612891</p>	<p>Interview</p>	<ul style="list-style-type: none"> <li>• Wants electricity in the district</li> <li>• Feels there is a need to harmonise different works of the state with the environment</li> <li>• As a politician he feels UMEME and Environmental practitioners consulting him symbolises that he's working in a team.</li> </ul>	<ul style="list-style-type: none"> <li>• UMEME has plans to upgrade the Iganga – Kaliro network to ensure a steady power supply to various users in the district.</li> <li>• The civil works will take 3 months,</li> </ul>

		<ul style="list-style-type: none"> <li>• How long will it take to set up the station? Development in the district highly relies on power availability.</li> <li>• He is confident UMEME will not install a station that will be hazardous to human health</li> </ul>	<p>followed by electrical installations which will require 2-3 months before they are fully operational.</p>
<p>Gabriel Fataki District Engineer, KDLG 0772988313</p>	Interview	<ul style="list-style-type: none"> <li>• There is no doubt that land belonged to UEB</li> <li>• There are 2 schools on either side of the proposed developments and houses around there might have increased since the 1970's. Have they been contacted?</li> <li>• Will there be any relocation / compensation for people surrounding the area?</li> <li>• The substation should be isolated somewhere. Has UMEME thought of the possibility of relocating their project to somewhere more practical?</li> <li>• No one got in touch before upgrading the voltage lines from 11KV to 33kv.</li> <li>• Address all health and safety concerns, wants to know what the impact of underground cabling is and how different it is from over ground lines.</li> <li>• Safety measures will have to be in place in case of accidents</li> <li>• Needs to see a civil plan before he can comment on civil works</li> <li>• He doesn't have record of the power demand for Kaliro</li> </ul>	<ul style="list-style-type: none"> <li>• Yes the schools were contacted and they were happy to have UMEME put a substation next to their premises.</li> <li>• The substation is to be placed at an area of 61 by 61 m, for which UMEME holds tenure rights, landtake from neighbours will not be necessary.</li> <li>• Substation redevelopment plans already approved by the Town Council</li> <li>• Measures to isolate the site are in place, including a wall fence, employment of guards and security lighting</li> </ul>
<p>Wancha Tom Francis District Planner, KDLG 0772587751</p>	Interview	<ul style="list-style-type: none"> <li>• Any infrastructural development of this kind can lead to small scale industry development</li> <li>• Maize and rice is grown in Kaliro and maize and rice mills utilise electricity</li> <li>• There is also a sawmill. He doesn't have details of energy demand</li> </ul>	<ul style="list-style-type: none"> <li>• The network upgrade covers major rural growth centres in the district to 11 KV</li> <li>• The network upgrade caters for the needs of small scale industries</li> </ul>

<p>Kasadha John Stephen, Town Clerk Kaliro Town Council 0772898966</p>	<p>Interview</p>	<ul style="list-style-type: none"> <li>• Never seen anything in the named area</li> <li>• Can not confidently comment on the sub-station's pre-existence as there is no documentation on it.</li> <li>• Wants to be assured that the project has no adverse impacts on the health of the surrounding community</li> <li>• Risk of fires. How will that be dealt with?</li> <li>• What would happen in the event of war and vandalism?</li> <li>• Three fruit trees were cut to redevelop this substation. Would UMEME be willing to plant replacements? The main road was suggested as a suitable place.</li> <li>• Waste oils, how will they be treated?</li> </ul>	<ul style="list-style-type: none"> <li>• New designs will be used and these will be more resilient and less likely to spark or cause fire hazards</li> <li>• The substation will be secured with a fence and guarded.</li> <li>• The environmental practitioners will provide UMEME with details of suitable tree species to plant along the road.</li> <li>• The plans have provisions for oil sumps. Waste oils will be regularly removed by the UMEME Ltd maintenance team for recycling or disposal.</li> </ul>
<p>Rose Tulirabirawo  Kaliro Town Council Engineer</p>	<p>Interview</p>	<ul style="list-style-type: none"> <li>• What is the clearance from main road and houses?</li> <li>• Existing poles in the roads in Town need to be moved</li> <li>• What protection is in place in the event of electricity and lightning interacting?</li> <li>• Need to move the technical office from Jinja to somewhere closer.</li> </ul>	<ul style="list-style-type: none"> <li>• Any faults will be redirected to the main station.</li> <li>• Faults will automatically cause trips to isolate the faulty line.</li> <li>• The office in Iganga is not closed permanently and Kaliro will get a district office when the substation is operational.</li> </ul>
<p>Sebagabo Johnson  Environmental Health Officer- Kaliro Town council</p>	<p>Interview</p>	<ul style="list-style-type: none"> <li>• Complaints from people about UMEME placing poles on their land without permission</li> </ul>	<ul style="list-style-type: none"> <li>• UMEME always compensates land owners and consults them before planting a pole.</li> </ul>
<p>Directors of Kaliro College Secondary School Ekisa John Bird - 0712648883 Tidamulala Tom John - 0752870855 Omeri Emmanuel – 0753027837</p>	<p>Interview</p>	<ul style="list-style-type: none"> <li>• Stated School in 1998</li> <li>• There have threats that the School buildings will be demolished, and School children withdrawn;</li> <li>• The School will benefit from improved power supply for lighting and to run machinery, security lights, previously deficient;</li> <li>• Incidents of power lines surging and collapsing due to high load</li> </ul>	<ul style="list-style-type: none"> <li>• UMEME Ltd will sensitise the school neighbours on the dangers of the substation and appropriate behaviour;</li> <li>• Power lines to the substation have already been upgraded;</li> <li>• The substation will</li> </ul>

		<p>have been common. An upgrade was timely;</p> <ul style="list-style-type: none"> <li>• Neighbours complains of dangers of electrocution will be handled by fencing;</li> <li>• The school will construct a fence to further deter students from the substation premises.</li> </ul>	<p>be isolated with a fence and will have guards to provide 24-hrs security and surveillance</p>
Zowena Nkono, LC1 Chairperson, Nakiyanja Zone, Kaliro Town Council	Interview	<ul style="list-style-type: none"> <li>• Supports the project. It will bring development to all people of Kaliro district</li> </ul>	<ul style="list-style-type: none"> <li>• UMEME Ltd will sensitise the local community on project benefits.</li> </ul>
Lydia Mpanja, Subcounty Chief, Namugongo subcounty	Interview	<ul style="list-style-type: none"> <li>• Noted Namukoge and Nabikoli as town centres demanding/lacking power</li> <li>• Power extended to Bumanya but inadequate for the Health Centre IV</li> <li>• For Namugongo poles replaced, but transformer faulty, power deficient</li> </ul>	<ul style="list-style-type: none"> <li>• Redevelopment of Kaliro substation will ensure improved power supply;</li> <li>• With a substation at Kaliro and a district office for UMEME Ltd, rectification of faults will be faster</li> </ul>

## CHAPTER 7: ENVIRONMENTAL IMPACT ANALYSIS AND MITIGATION

### 7.1 Overview

This chapter identifies and evaluates significant environmental consequences related to the redevelopment of Kaliro Substation. The project in question does not have irreversible environmental impacts on the environment. However, the likely impacts if not mitigated are likely to be injurious to the bio-physical and social environment. While positive attributes of this project should be enhanced, mitigation measures should be put in place to minimize or eliminate the likely negative environmental impacts.

Redevelopment of Kaliro substation can result in environmental impacts, which are categorized and assessed as follows:

- Extent: within limited area (<200m from site), local (up to 10 km) or wide (district, regional or global)
- Duration- Temporary (<1 year), short term (1-5 years), medium term (5 -10 years long term (> 10 years - L) or permanent;
- Magnitude of impact – Low, medium or high
- Probability of occurrence - Low, Medium or High
- Overall assessment of impact - Negligible, minor, moderate, substantial or severe

To systematically evaluate the impacts associated with this development activity, an impact matrix has been constructed as per the categories identified. Table 7.1 presents this analysis and identifies significant environmental impacts. A discussion of these impacts and their mitigation is presented in the following sections.

**Table 7.1: Matrix For analysis of negative environmental impacts during site decommissioning/preparation, Construction and Operations**

Activity / Impact	Extent	Duration	Magnitude	Probability of occurrence	Overall assessment
<b>Preparation and construction/development phase</b>					
Noise and dust from construction work	Within Limited area	Temporary	Medium	Medium	Minor
Exhaust from haulage vehicles	Within Limited area	Temporary	Low	Low	Negligible
Traffic interference and accidents on the Iganga-Kaliro highway	Local	Temporary	Medium	Low	Minor
Loss of vegetation due to site clearance	Within Limited area	Short term	Medium	Low	Minor
Solid waste from construction activities	Within Limited area	Temporary	Medium	Medium	Minor
Pollution from waste oils	Within Limited area	Short term	Medium	Low	Minor
Pollution from faecal waste	Within Limited area	Temporary	Medium	Low	Minor
Habitat loss for site fauna/flora	Within	Short term	Medium	Medium	Moderate
Interruption of power supply to Iganga – Kaliro network	Wide	Temporary	Medium	High	Moderate
Occupational health and safety hazards, particularly electrocution	Within limited area	Temporary	High	Medium	Moderate
<b>Operations and maintenance phase</b>					
Noise from transformers	Within limited area	Long term	Low	Low	Minor
Traffic interference on Iganga – Kaliro road	Within limited area	Long term	Low	Low	Minor
Occupational health and safety hazards for workers and neighbours	Within limited area	Long term	Medium	Medium	Moderate
Pollution from waste oils from transformers	Within limited area	Long term	Low	Low	Minor
Pollution from sanitary waste, including faecal wastes	Within limited area	Long term	Low	Low	Minor
Impact on area aesthetics	Within limited area	Long term	Medium	Medium	Moderate
Risk of fire outbreaks	Within limited area	Long term	Medium	Low	Moderate
Risk of electrocution of neighbours	Within limited area	Long term	High	Low	Substantial
<b>Decommissioning phase</b>					
Occupational health and safety	Within limited area	Temporary	Low	Low	Minor
Community health and safety	Within limited area	Temporary	Low	Low	Minor
Pollution from debris from during site decommissioning	Within limited area	Temporary	Low	Low	Minor
Pollution from waste oil and electronic waste	Within limited area	Temporary	Medium	Medium	Moderate

Impact on area aesthetics	Within limited area	Long term	Low	Low	Minor
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## 7.2 Pre-construction and site development phase (civil works)

This phase involves site decommissioning and clearing prior to construction. This site initially had a plinth

### 7.2.1 Air quality

Exhaust fumes from haulage vehicles and from fugitive dust could impact on air quality. Given the neighbouring land use, this will be of particular concern to other developers. However levels of mechanised works will be low, and a limited number of vehicles involved, and the impact on air quality will be minimised. Transported material will be covered with tarpaulins to limit dust nuisance along the roads.

### 7.2.2 Noise generation

Noise generation will be mainly from construction vehicles and equipment. Most of the civil works will be manual hence limiting impact of noise. Welding, and other works likely to generate noise will be limited to evening hours and weekends when activity at the neighbouring schools is low.

### 7.2.3 Traffic interference

Access to the site from the Iganga-Kaliro Road poses a danger of accidents to motorists and pedestrians. The site is on a straight stretch and visibility will not be interfered with since the substation is off the road reserve. There will be road signs indicating warning of trucks turning to the site.

### 7.2.4 Loss of Vegetation and Tree cover during site clearance

This site was vandalized and equipment lost in the 1970's. It has since been covered with bush which was cleared by UMEME Ltd and three mango trees were cut down. In compensation, Kaliro Town Council has requested UMEME Ltd to support greening activities and UMEME Ltd will undertake tree planting along the Iganga – Kaliro road. Re-vegetation around the site after construction limitation of paving at the substation will limit run-off water leaving the site that could cause soil erosion.

### 7.2.5 Effects of debris and solid waste generated during site preparation

The exercise will generate significant amounts of construction debris while undertaking excavations and landscaping. The excavated soils and debris could spill into the neighboring road reserve. Efforts will be made to deliver excavated soils and debris to parts of the Town where landscaping is required or to other construction sites. Some of the excavated earth will be used to improve the access road the neighbouring School.

All the switchgear and equipment was earlier recovered by UEB. The plant was demolished by UMEME Ltd and a new one will be constructed.

### 7.2.6 Land take leading to conflicts with neighbours

The size of the substation is 61x 61m for which tenure exists with UEDCL. The designs for the substation restrict developments to this area. No additional land will be required for the infrastructure to be put in place, and there will be no encroachment on neighbouring sub-leased land or road reserve.

The access road to the neighbouring school has already been moved away from the UMEME Ltd plot. UMEME Ltd has helped in grading this new access road.

**Figure 7.1: new access road to the Kaliro College School graded by UMEME Ltd**

### **7.2.7 Occupational health and safety hazards**

There are a number of concerns relating to site preparation and civil works the substation prior to installation of electrical equipment. UMEME Ltd has safety guidelines that will be strictly followed during this phase, which have been emphasized in the environmental monitoring and management plan. All contractor workers will undergo induction prior to commissioning of works, and only authorized personnel will be allowed access to this site during construction.

Besides, the employees involved will be provided with the required PPE and work permits procedures strictly enforced to avoid any incidents such as electrocution.

### **7.2.8 Land contamination with oil spills**

There is a possibility of contamination of the soil on site with waste oil from construction equipment. Servicing of vehicles and other equipment will be done in designated areas (garages and workshops) and not at this site.

### **7.2.9 Occupation health and safety hazards, including electrocution**

By the time of construction works, the site will be isolated from any power supply lines and fenced off. However maximum care will be taken during the construction phase to check the status of isolation of the electrical power supply lines. Work permits will be utilized for access to the site by workers.

PPE will be provided and utilized by the workers, including hard hats, gloves, gumboots, hard boots, and eye glasses, among others. A First Aid Kit will be available on site for use by the workers in case of minor injuries.

Clearances from existing energized electrical wires and poles will be observed as stated in Table 7.2.

### **7.2.10 Disposal of sanitary and other human waste**

Given the numbers of workers expected to be involved during the construction phase, there is a risk of polluting the neighbourhood if proper measures are not taken to safely dispose off these wastes. This could result in spread of diseases such as cholera. Other than debris, plastic bottles, polyethylene bags, cans, food remains, and scattered paper are common at construction sites.

UMEME Ltd will endeavor to ensure waste collection infrastructure is put in place including coded waste bins for different categories of waste, and timely pick up services for disposal of this waste by licensed waste collectors to designated sites. A single stand VIP Latrine will be built for workers at the site, and utilized for future operations.

### **7.2.11 Effects of extraction and transportation of raw materials from source points**

Most of the materials such as rock blocks, local sand, bricks, timber, poles and cement, will be procured locally. Management will ensure these materials are purchased from those issued licences by the KDLG and obtaining their materials in an environmentally friendly way, and holding operating licenses.

## **7.3 Substation commissioning, operation and maintenance phase**

### **7.3.1 Occupational health and safety hazards**

These could arise during plant commissioning, maintenance and operations. New developments at the substation include installation of a new earth mat, proper earthing of all points to the earth mat, metering on the power transformers and 11KV feeders, tap changer panels, AC/DC station distribution board, appropriate protection schemes, labelling of switch gear and equipment and various occupational health and safety provisions.

Electrical and working clearances have been considered in the design of this substation (see

table 7.2). For above ground works, additional measures will be required.

There will be signage at the entrance and perimeter fence of the substation prohibiting unauthorised persons from entry, handling or interfering with electrical installations, machinery and a warning of electrical shock “Hazard” sign. For cases of emergency, there will be a notice of procedure in case of fire, and a notice of how to resuscitate persons in case of electrical shock.

There will as well be correct and up-to-date diagrams to avoid mal operation that could cause electrocution and deaths, and loss of equipment. Marking and labelling of all cables, wiring and equipment will be done as per standards at UMEME Ltd.

Electrical tests will be undertaken prior to commissioning of the Kaliro substation, to limit damage to equipment, ensure human safety around and in the plant, limit impact on the neighbouring environment and ensure uninterrupted power supply. These tests allow for

- Early detection and localisation of FAULTS; and
- Rapid tripping-out of the FAULTED equipment.

UMEME Ltd standard operating procedures will be used in undertaking these tests. Power system protection tests will be undertaken during decommissioning and commissioning. Protection provided includes fuses and magnetic circuit breakers, and protection equipment include relays, current and voltage transformers, HV and LV circuit breakers, temperature measurement devices and Buchholz relays on power transformers, and D.C supplies.

**Table 7.2 Standard electrical and working clearances**

Nominal System Voltage (kV)	Maximum System Voltage (kV)	Minimum Safety Clearance (M)		Minimum Clearances in Metres					Minimum Working Clearances in Metres	
		Phase to earth	Phase to Phase	Above ground outside townships	Above ground inside townships	Above roads in townships, pro-claimed roads outside townships and railways	To communication lines, other power lines or between power lines and cradles	To buildings, poles and structures not forming part of power lines	Vertical	Horizontal
≤ 1,1				4,9	5,5	6,1	0,6	3,0		
6,6	7,2	0,15	0,20	5,0	5,5	6,2	0,7	3,0	2,6	1,2
11	12	0,20	0,27	5,1	5,5	6,3	0,8	3,0	2,7	1,3
22	24	0,32	0,43	5,2	5,5	6,4	0,9	3,0	2,8	1,4
33	36	0,43	0,58	5,3	5,5	6,5	1,0	3,0	2,9	1,5
44	48	0,54	0,73	5,4	5,5	6,6	1,1	3,0	3,0	1,6
66	72	0,77	1,05	5,7	5,7	6,9	1,4	3,2	3,2	1,8
88	100	1,00	1,15	5,9	5,9	7,1	1,6	3,4	3,3	1,9
132	145	1,45	1,65	6,3	6,3	7,5	2,0	3,8	3,7	2,3

### **7.3.2 Risks of fire**

For cases of a fire outbreak, there will be 10kg and 25kg cylinders for fire fighting. Besides private fire fighting companies such as Fire Masters and the Police Fire Brigade Division will be on call in cases of fire incidents. UMEME Ltd also provides staff with training in emergency procedures and Fire fighting and this can be on call in case of such incidents.

### **7.3.3 Pollution from transformer oil spillage and waste oils**

Transformer plinths will be constructed and will include oil sumps. This oil will be regularly drained during transformer servicing, and any spilled oils collected by UMEME Ltd maintenance staff to be taken to a central collection point in Kampala for recycling or final disposal.

### **7.3.4 Loss of aesthetics**

Given the site environment and neighbourhood of schools and residences, there is need to limit visual intrusion that would affect aesthetics in the area. The proposed designs for buildings, plinths, heights and arrangement of colours match the green of the surroundings.

Substation design and development will ensure that the substation will “blend in” as best as practically possible with the surrounding environment. The following criteria shall be considered with regard to the visual aspect of the substation:

- Height: the substation shall be designed and constructed to ensure that the heights of the substation structures are equal to or less than the surrounding buildings/trees/horizon;
- Surface area: the total surface area of the substation, including access road, shall be kept to a minimum. In this case, restricted to the leased area;
- Boundary with the environment: the substation shall be constructed so as to ensure that it does not significantly change the appearance of the area in which it is located. This will be ensured by landscaping, construction of walls and the planting of vegetation that will help to conceal the substation. The exterior will be painted in UMEME Ltd colours and the surrounding area planted with trees;
- Underground cabling at the substation will be emphasized to limit overhead cables that would affect area aesthetics

### **7.3.5 Site security**

The substation will be fenced off with a wall fence. There will be a security house and communication system installed. A private security firm will be engaged to ensure no intruders enter the substation premises and to communicate any incidents to the relevant authorities (see figure, plate c). This has been the case for most of UMEME Ltd installations.

UMEME Ltd will also ensure security lighting at the substation and immediate neighbourhood is provided.

UMEME Ltd will undertake sensitisation of the neighbourhood community, particularly the schools and the local residents on the dangers of accessing the substation premises, and ensure their involvement in monitoring incidents at the substation.

### **7.3.6 Noise from the substation**

Given the nature of neighbouring land use, noise generated once the substation is commissioned needs to be mitigated. The use of a wall fence will reduce the level of noise to the neighbouring schools.

## **7.4 Summary of electrical equipment commissioning and operational mitigation measures**

Table 7.3 provides a summary of required commissioning tests and operational mitigation measures for the substation.

**Table 7.3 Summary of commissioning and operational mitigation measures**

Project stage	Activity/Test	Impact	Mitigation measures
Commissioning	Insulation resistance measurement	Operation of the relays during the test which leads to blowing up of equipment and fires which is harmful to the equipment, building and humans around the substation	<ul style="list-style-type: none"> <li>When taking measurements, the earthing terminal block is to be open</li> <li>The DCs must be off including those to the relay and metering equipment to avoid operation of the relays during the test</li> <li>If the circuit is included in a bus bar protection in which the circuits are switched with the aid of disconnectors, the position of the latter must be so as to ensure that all parts of the circuits are connected</li> </ul>
	Magnetization curves	Malfunction due to internal transformer fault which leads to blowing up of equipment and fires which is harmful to the equipment, building and humans around the substation.	<ul style="list-style-type: none"> <li>Measured values to be compared with factory test results</li> <li>Check the circuits in accordance with the Inspection and test instruction for general transformer tests outlined in the inspection and test plan for site tests</li> <li>When recording the curve, the primary circuit is to be open.</li> <li>The ammeter is to be connected at “zero-level”, i.e. on the earthed side of the circuit.</li> <li>When using a step-up transformer the secondary circuit must be earthed</li> <li>The test connections are to be made as shown in the provided drawing</li> </ul>
	Primary injection	Danger to personnel and equipment in case of an open secondary circuit which leads to blowing up of equipment and fires which is harmful to the equipment, building and humans around the substation	<ul style="list-style-type: none"> <li>Prior to commencing the test a thorough check is to be made to ensure that the primary circuit is isolated, short circuited and safety-earthed especially if the items to be tested are included in, or are extensions of an existing plant.</li> <li>All persons who participate in the testing work are to be well acquainted with the risks involved and are to be properly informed regarding which plant sections are energized</li> <li>If for example, a neutral current flows despite that, in the case of the primary connection in question, no such current was anticipated, the test is to be interrupted immediately and is not to be continued until the fault has been remedied.</li> <li>Ensure that the protective relays, which are connected to the current transformers, are not overloaded during the continuous injection of high-magnitude primary current. If there are any risks of them being overloaded, they must be temporarily short-circuited internally. This applies particularly to the earth fault relays.</li> </ul>
	Winding temperature gauge calibration	Danger of fire due to a liquid introduced in the calibrator block	<ul style="list-style-type: none"> <li>An HV permit to work must be issued before commencing any work.</li> <li>Ensure that the LV and HV sides are isolated and earthed. Whenever practically reasonable, work must be carried out when the apparatus is dead.</li> <li>Due to the fact the thermostat is a portable instrument to be in the field, it is very important to ensure the socket has been earthed correctly when connecting it to the supply.</li> <li>Carry out the maintenance and repair operation only with the equipment at ambient temperature and disconnect the electrical cable.</li> <li>During the calibration process, the frontal</li> </ul>

			<p>protection grid may overheat and so don't touch the probe when it is in the block. After calibration, wait for the stabilization at ambient temperature before returning the calibrator to its carrying case.</p> <ul style="list-style-type: none"> <li>• Never put any type of liquid inside the block since the calibrator is suitable for operating with the consequent danger of fire.</li> <li>• Don't change the calibration parameters.</li> </ul>
	Operation of the Master relay	Failure to trip a related primary plant or distribute s trip and/or alarms to more than one Circuit Breaker or device which leads to blowing up of equipment and fires which is harmful to the equipment, building and humans around the substation	<ul style="list-style-type: none"> <li>• Ensure the operation of the master relay at all times</li> </ul>
	Buchholz relay protection	Great loss of oil and oil surge due to the failure of this relay which leads to blowing up of equipment and fires which is harmful to the equipment, building and humans around the substation	<ul style="list-style-type: none"> <li>• Issue an alarm/trip for a great loss of oil</li> <li>• Issue an alarm/trip for an oil surge from an internal fault (high current)</li> </ul>
	Transformer pressure relieve valve or explosion vent	Oil escape as a resulting of a tank bursting due to high pressure from an internal fault which leads to blowing up of equipment and fires which is harmful to the equipment, building and humans around the substation	<ul style="list-style-type: none"> <li>• To prevent the tank from bursting, the PRV opens, allowing some of the oil to escape.</li> <li>• When the internal pressure returns to normal, the valve snaps shut, keeping the oil spill to a minimum</li> <li>• The Pressure Relief Valve should also trip the HV and LV circuit-breakers through the "master" relay</li> </ul>
Substation operation and Maintenance	Sub station DC supplies (Batteries	Acid affecting the eyes	<ul style="list-style-type: none"> <li>• Always ensure there is tap at the entrance of the battery room</li> <li>• Constantly measure and record battery voltage and current and the voltage of all the cells</li> <li>• Check and clean all terminations and inter-connections</li> <li>• Ensure the battery charger is functional</li> </ul>
	Quality of oil	Poor transformer oil quality will lead to heating and blowing up of the transformer thus affecting its environment	<ul style="list-style-type: none"> <li>• Before commissioning, after 48hrs on load, after 1,3 and 6 months on load and annually thereafter and also within 24hrs after a fault to check for the following: Dielectric strength, water content, dissolved gas analysis and acidity</li> </ul>
	Electrical fires	Loss of equipment and life within and around the substation due to combustion of cables, oils and metals in the presence of electricity	<ul style="list-style-type: none"> <li>• Ensure oil spillage is kept to a minimum</li> <li>• Apply fire proof coating onto the cables</li> <li>• Have many points to isolate the electricity in this event</li> <li>• Use fire detection and protection equipment</li> <li>• Conduct fire training for staff</li> <li>• Install a fire wall between the two transformers</li> <li>• Have personal protection equipment</li> </ul>

	Electrical shock	Disturbance of the respiration and circulation system, severe burns and possible death	<ul style="list-style-type: none"> <li>• Ensure you are always dry when working on electrical equipment including the attire</li> <li>• Ensure you have shock resistant boots and gloves</li> <li>• Ensure you are wearing your PPEs</li> <li>• Always ensure that you are clear of live apparatus or conductors</li> </ul>
	Oil spillage	Possible cause of fire and eventual death	<ul style="list-style-type: none"> <li>• Have a proper oil management system</li> <li>• Always drain and dispose off the spilled oil</li> </ul>
	Substation minimum electrical safety and working clearances	Possible cause of death due to working at heights as a result of falling or as a result of coming into contact with a conductor hence a shock	<ul style="list-style-type: none"> <li>• Always stick and adhere to the standard safe working clearances in substances</li> </ul>
	Earthing of the substation and equipment	By law and standard practice an earth must be provided to minimize risk to life, limb and equipment.	<ul style="list-style-type: none"> <li>• Always ensure that at all times an immediate safe discharge of electrical energy to the general mass of earth and indicate that apparatus are safe to work on.</li> </ul>
	Electromagnetic fields	Varied risk to humans	<ul style="list-style-type: none"> <li>• Construct a wall fence</li> <li>• Ensure a clearance of 10m from recreation areas during installation</li> </ul>
	Protection system	Damage to equipment, human life and environment around the system and also non-continuity of power supply if the protection failed to work	<ul style="list-style-type: none"> <li>• Ensure all the protection systems are tested and commissioned</li> </ul>

## **7.5 Project benefits**

This EIS has thoroughly discussed the benefits of redevelopment of Kaliro substation. Key among these are:

### **Improved power supply to Kaliro District**

This substation is urgently required to handle the increased demand for electricity within the district, and to relieve the Iganga substation of the 11KV loads. This will greatly boost the district's social services delivery, particularly health services, and economy with a steady power supply and increased production hours and will also create jobs.

### **Increased electricity fault handling**

The presence of a substation in Kaliro town will call for a district UMEME office to be established in Kaliro Town. This will bring services like fault handling and electricity provision/distribution enquiries closer to people in Kaliro district.

### **Security in Kaliro Town**

Redevelopment of this substation provides an opportunity to ensure uninterrupted power supply around the site and the neighbouring schools. This will provide lighting on the streets especially at night.

### **Improved aesthetics**

Kaliro Town Council has proposed to allocate land within the Town for UMEME to plant trees along the Iganga-Kaliro highway.

## **CHAPTER 8: ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN**

The EIA team proposes an impact-mitigation-responsibility matrix to facilitate effective implementation and monitoring of the activities of the proposed development. The management of UMEME Ltd will be entirely responsible for the implementation of this mitigation plan including the requisite resources.

**Table 8.1: Impact – Mitigation – Monitoring and Responsibility matrix**

Impact issues	Indicators	Mitigation	Frequency of monitoring	Responsibility
<b>Site preparation and construction</b>				
Air quality	Records of complaints of dust and exhaust emissions from construction vehicles by neighbouring schools	Put in place barriers to prevent dust reaching the neighbourhood Ensure contractor vehicles are in good working conditions	Weekly checks by UMEME Ltd to ensure good site practices by contractors	KTC, DEO, Contractor UMEME Ltd
Human sanitary waste	Human waste littering the site and immediate neighbourhood	Construct waterborne latrines at site	Regular checks by UMEME Ltd	KTC, DEO, Contractor, UMEME Ltd
Solid wastes	Litter at the site and immediate neighbourhood	Put in place coded waste collection bins; Hire a licensed waste collection firm	Weekly checks by UMEME ltd, KTC to ensure appropriate waste disposal	KTC, DEO Contractor UMEME Ltd
Oil wastes	Contamination of soils and ground water Litter of oil wastes at site	Ensure no vehicle maintenance takes place at site; Provide coded waste bins for waste segregation	Regular checks by UMEME Ltd	KTC, DEO Contractor UMEME Ltd
Traffic	Record of traffic offences and accidents along Iganga-Kaliro road	Provide induction training to truck drivers Put in place signage indicating turn off point	Regular checks by UMEME Ltd,	Contractor UMEME Ltd, KTC, District Engineer
Occupational Health and Safety	Records of accidents, including electrocution	Have a First Aid Box on site Ensure proper isolation of all electrical and energized drives Provide appropriate PPE for the workers	Regular checks by UMEME Ltd and the contractor	Contractor UMEME Ltd KTC
Loss of vegetative cover leading to soil erosion	Number of trees cut	Plant areas allocated by KTC as compensation for lost fruit trees at site Undertake proper landscaping after construction	Monthly water quality monitoring; Regular checks by UMEME ltd and Contractor for vegetation	UMEME Ltd Contractor KTC, DEO
Noise generation	Record of complaints from neighbouring School, residents	Limit noise generating works such as excavation to early morning or late evening hours Limit vehicle movement to the site	Regular checks by UMEME Ltd Continuous checks by contractor	UMEME Ltd Contractor KTC, DEO
Land take	Complaints from neighbours	Restrict developments to leased area Stick to approved plans by KTC	Regular checks by UMEME Ltd, KTC (Planning)	UMEME Ltd Contractor KTC

<b>Commissioning, operations and maintenance phase</b>				
Occupational health and safety issues, and community safety	Reported incidents of electrocution, fire-outbreaks, accidents	Implement the UMEME Ltd safety guidelines; Put in place signage; Undertake various protection tests prior to commissioning; Ensure appropriate PPE is provided to workers and used; Isolate the site from intruders and neighbourhood; Restrict access to the substation to authorised persons; Ensure appropriate clearances are observed during maintenance and installation of electrical equipment	Regular checks by UMEME Ltd, contractor, KTC, Ministry of Labour	UMEME Ltd Contractor KTC DEO Ministry of Labour
Loss of vegetative cover, shade and aesthetics	Reduced number of trees	Replant trees in an appropriate part of the town and along the Iganga-Kaliro highway; Undertake appropriate site landscaping after construction completion; Ensure finishing at the site, including painting blends well with the environment; Limit overhead cabling	Regular checks by UMEME Ltd, contractor, KTC	UMEME Ltd Contractor KTC, DEO
Transformer oil spillage, and other oil wastes	Incidents of transformer oil spillage Contamination of site soils with hydrocarbons	Construct oil sumps to prevent spilled or leaked transformer oil from contaminating surface and ground water; Adequate facilities shall be provided for the temporary safe storage of used or spilled transformer oil to ensure safe disposal later; Waste oil drainages shall be constructed around transformer plinths.	Regular checks by UMEME Ltd, contractor, KTC	UMEME Ltd, Contractor KTC, DEO, Engineer
Electromagnetic fields	Long term impacts of electromagnetic fields due to exposure	Construct a wall fence Ensure transformer clearance of 25m from schools and neighbouring houses	Regular checks by UMEME Ltd, contractor, KTC, DEO A	UMEME Ltd Contractor KTC, DEO, Engineer, Health Inspector
Site security	Reported incidents of vandalism, thefts	Provide security lighting at the site	Regular checks by UMEME	UMEME Ltd

	or attacks by thugs	and immediate neighbourhood; Employ guards from a reputable security firm, with at least 2 at the site all the time	Ltd, contractor, KTC	Contractor KTC, DEO, Engineer,
Noise generation	Complaints from school goers about noise generation	A wall fence will be constructed to reduce noise impact	Regular checks by UMEME Ltd, contractor, KTC	UMEME Ltd Contractor KTC, DEO, Engineer
Risk of fire	Records of fire outbreaks at the substation	Undertake regular maintenance Regular checks of protective systems Provide fire fighting equipment at site Train staff in fire fighting	Regular checks by UMEME Ltd, contractor, KTC	Contractor KTC DEO, Engineer
Solid waste	Waste littered at substation and neighbourhood	Provide waste bins for waste collection Ensure timely collection and disposal of solid waste by contractor	Regular checks by UMEME Ltd, contractor, KTC	Contractor KTC, DEO

## **CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS**

### **9.1 Conclusions**

The proposed upgrade of Kaliro substation does not necessarily have irreversible environmental impacts on the environment; and the likely adverse impacts have been considered and mitigation measures proposed for all development stages: design, site preparation, site decommissioning, construction, commissioning, operation and maintenance phase to ensure environmentally sound power facility development.

With implementation of proposed mitigation measures, negative impacts of this project will be eliminated or minimised. Impacts resulting from loss of tree cover, waste generation, an on occupational health and safety, as well as area aesthetics can be mitigated. This project is environment friendly and economic promoting.

No adverse social impacts are expected due to this upgrade, and any arising will be more than compensated for by the opportunities offered by this project.

### **9.2 Recommendations**

It is recommended that NEMA, UMEME, Ministry of Energy and Mineral Development, ERA, Local Authorities and other relevant authorities approve the environmental aspects of this project.

The developed environmental management and monitoring plan should be implemented, and the UMEME Ltd should ensure any other adverse impacts that come up in the course of implementing the project are addressed immediately.

An additional environmental study should be commissioned in case the developer wishes to introduce any other structure/activity which is not considered under this assessment.

Regular environmental audits of the facility should be carried out at least once every year preferably by a competent environmental auditor (s) and reports submitted to NEMA for review and ascertain compliance with terms of approval.

## References

1. Forestry Department (2003). National Biomass Study: Technical Report. Kampala, Uganda.
2. Howard, P.C. 1994. An annotated checklist of Uganda's Indigenous trees and shrubs. Uganda Forest Department, Kampala.
3. Kaliro District Local Government (2007): Three Year Development Plan for BDLG, 2007 – 2010;
4. Katende, A.B., Birnie, A and Tengnas, B. 1995. Useful trees and shrubs of Uganda. Regional Soil Conservation Unit, Nairobi.
5. NEMA (2007): State of Environment Report for Uganda, 2005/2006;
6. Uganda Bureau of Statistics (2005). The 2002 Uganda Population and Housing Census – Main Report. Kampala, Uganda.

## Appendices

## **Appendix 1: Terms of reference for the EIA of Redevelopment of Kaliro Substation In Nakiyanja Zone, Kaliro Town Council, Kaliro District**

### **1.0 BACKGROUND**

#### **1.1 Introduction**

UMEME Ltd holds a concession to lease and operate the UEDCL distribution infrastructure and to supply retail electricity. The concession applies to the Authorised Territory which is the area covering a 1.0 km radius around the existing UEDCL infrastructure (33kv, 11kv and LV reticulation networks) and extends throughout the country.

This development is in line with UMEME Ltd objectives, that include: Stabilizing the management of the utility; Investing capital in the critical areas of the network to improve quality of supply; Reduction of non technical losses and arrears; Systematically transforming the business by introducing modern technology and world best practices to achieve our vision of becoming the leading East African Distributor of electricity by any measure, by 2010.

#### **1.2 Project description**

UMEME Ltd intends to redevelop the Kaliro substation located at Kaliro Town, 34 km from Iganga Town. UMEME will introduce one 2.5 MVA transformer, with an additional 2.5 MVA planned for the second phase. This has become necessary given the excessive load growth for the Iganga substation which also has outlets to Iganga Town, Mbale and Busia, Tororo and Bugiri in the city centre. There is also increasing demand from Kaliro district and the existing supply unable to sustain demand from small scale industries mushrooming in the area.

Overhead cables linking Iganga to this substation have already been upgraded from the previous 11 KV to 33 KV. The old transformer installations were earlier decommissioned by UEDCL.

The size of the substation site is 61 X 61 m for which tenure exists with UEDCL. Proposed works will involve civil and electrical works, and include:

- General grading and fill to raise the area to house the transformer plinth, cable ducts and plant house and filling the whole site with 150mm thick layer of compacted murram, 25mm layer of chippings in areas with electrical installations and walkways. Grass will be planted on sections of the site without installations;
- Erection of the DC plinth for a 4 ton transformer, with has provision for retaining all the oil from the transformer;
- Erection of a plant house;
- Construction of an access road from the main road (Iganga- Kaliro) to the substation, and within the station, and parking area for service vehicles;

- Construction of a perimeter fence around the substation, steel gate and guard house;
- Construction of a one stance ventilated improved pit latrine;
- Provision and construction of the substation grounding (earthing) system.

Other works will include:

- Proper earthing of all necessary points in the substation to the earthmat;
- The electrical wiring of the Plant house;
- Installation of lights and power points inside the Plant House;
- Installation of perimeter lighting in the substation Yard;
- Provision, installation, wiring and commissioning of all switchgear and appropriate protection schemes, including those of the Power Transformers;
- Installation of metering required on the Power Transformers and the 11 kV feeders (Elster A 1700 meters).

### **1.3 Purpose of this EIA**

The National Environment Act CAP 153 introduced the requirement for an Environmental Impact Statement into the Uganda Laws. Section 19 (3) of the National Environment Act, CAP 153 requires that all projects or policies that may, are likely to or will have significant impacts on the environment be subjected to EIA so that adverse impacts can be eliminated or mitigated. The third Schedule of this act lists development of electrical infrastructure in section 10, including electrical power substations, as projects for which an EIA is mandatory.

In undertaking this EIA, The EIA regulations and EIA Guidelines for the Energy Sector will be a useful resource.

### **Objective of the EIA study**

The objective of the EIA study is:

- To identify all likely positive and negative environmental impacts due to the proposed redevelopment of Kaliro substation;
- To identify and evaluate all significant negative environmental impacts, and propose appropriate mitigation measures for the attention of the developer/UMEME Ltd, for incorporation into the construction and operational phases;
- To compile an environmental impact statement report including an environmental management plan for all aspects of the proposed redevelopment of Kaliro substation for submission to NEMA for consideration for approval.

## **2.0 SCOPE OF ENVIRONMENTAL IMPACT ASSESSMENT AND METHODOLOGY**

The Environmental Impact study will be carried out in accordance with the National Environment Act CAP 153 and the Environmental Impact Assessments Regulations, 1998.

The proposed terms of reference will include examination of the substation environment, its components, activities, impacts of previous and proposed redevelopment and future operations recommendations and an environmental management plan for future substation operations.

In order to fulfil the requirements of the task ahead, a number of methods will be applied. These will include literature review, field visits, consultations, direct observations, and scientific data analysis and specialised studies.

The consultants will undertake the following tasks:

- Review of literature and secondary baseline data including area infrastructure such as power demand trends, supply and distribution network, area land use, sensitive ecology, socio-economic aspects, etc;
- Review of legislation and environmental standards related to proposed development;
- Field studies, that will include land use mapping, utilities and common properties mapping, topographic surveys, site geophysical mapping, receptor systems baseline data, noise measurements and an inventory of activities in the neighbourhood likely to be affected;
- Consultations with stakeholders, particularly the neighbours to the UMEME substation, relevant government agencies (NEMA, ERA, UEDCL, UETCL, MoEMD), local authorities (District CAO, District Planner, District Engineer, Natural Resources and Environment Officer, Community Development Officer, Kaliro Town Council Technical Staff, beneficiary subcounty chiefs) and other utility agencies to establish concerns related to substation redevelopment and future operations;
- Prediction and analysis of environmental impacts resulting from proposed substation redevelopment, and proposing appropriate mitigation measures;
- Development of an Environment Management and Monitoring Plan for implementation by UMEME Ltd;
- Preparation of an Environmental Impact Assessment report and presentation to NEMA for review and approval.

### **2.2 Project environment baseline conditions**

The project environment baseline conditions will be studied and related to the proposed substation redevelopment.

#### **2.2.1 The Physical Environment**

Site drainage, soils and hydrogeology, land use and land cover of the area will be studied and described.

Natural drainage around the site and management of run-off from the main road and upstream will be mapped and studied, as well as historical or local indigenous

knowledge on storm water and flood regimes documented. Of particular interest will be storm water drainage from the main road and development of a civil solution as a mitigation measure.

### **2.2.2 The Biological Environment**

The flora, fauna and other sensitive habitats and ecological system will be described, and their fate with development of this substation.

In relation to the aquatic environment, mitigation measures that will avoid oil spills at the site will be studied and proposed. Subsurface formations and area soil profile will be determined and measures to protect ground water in the site designs proposed.

### **2.2.3 The Socio- economic Environment**

Existing land use, developments, economic activities, infrastructure and their interrelationships with the proposed substation redevelopment will be studied.

Of major concern will be safety considerations given the land use in the neighbourhood which includes a school, residential areas and commercial business premises.

Traffic management along Iganga – Kamuli road will be considered during the construction and operation phase of this substation. Incremental social impacts of proposed development, such as improved social services and power supply for industrial developments will be studied. In this regard, consultations with sub-county level technical and political leaders will be undertaken.

Previous social impacts will be considered, including incidents at the substation prior to decommissioning. The benefits of this redevelopment to the area will be explored.

## **2.3 Environmental impacts of substation redevelopment**

Identification of the likely potential environmental impacts of the project activities in relation to the Physical, Biological, Socio-economic and Cultural Environment will be undertaken.

Principal impacts to be investigated include but not limited to;

- Environmental concerns associated with the various phases of this project that include site preparation, construction and the operation phase;
- Concerns of stakeholders regarding development of a substation at this site;
- Socio-economic and socio-cultural impacts related to or likely to arise due to this project;
- Conformity of the proposed development with national regulations and planning provisions of the area;
- Impacts associated with site landscaping;
- Impacts related to safety/welfare of UMEME and contractor workers, as well as the neighbourhood occupants.

### **2.3.1 Concerns Associated with Project Siting:**

In consideration of its location the following issues will be examined in detail;

- Conformity of the project with the planning provisions of the area and other regulatory requirements governing developments along major roads;
- Land tenure and competing land use at the proposed site;
- Traffic flow disruption and alternatives;
- Required infrastructure, including access roads, water supply, energy sources, and signage.

### **2.3.2 Concerns related to the construction of substation**

Regular impacts associated with this phase, which will have to be critically examined, include:

- Safety measures during construction for workers and local community, including traffic management;
- Excavations, levelling, and compacting during landscaping with the associated effects of noise, dust, possibility of accidents, soil erosion, disruption to drainage and loss of scenic value;
- Poor management of construction debris;
- Site spatial planning, including access roads, plant house, transformers, parking space, etc.

### **2.3.3 Concerns Associated With The Operation Phase.**

This study will have to investigate the following concerns and likely environmental Safety concerns of workers and site neighbours;

- Site isolation from the neighbourhood;
- Impacts of incidents such as fire outbreaks, electrocution;
- Oil waste generation and disposal;
- Noise and dust from the site operations;
- Change in land use, affecting ecological functions and economic activities;
- Impact on the socio-economic and cultural environment of the project area, such as pressure on existing infrastructure including traffic flow.

The EIA Team visited existing substations, including Iganga, and the recently redeveloped Jinja substation. Existing practices here will be reviewed as a basis for improved performance at the Kaliro substation. The pictures below present the Iganga substation and an improved Jinja substation.



### **3.0 EIA study output**

The major outputs of this study will include:

- An analysis of likely environmental impacts and appropriate mitigation measures, with particular reference to safety measures, civil solutions at the site, waste oil and other hazardous waste management, noise reduction measures, etc
- An environmental monitoring and management plan for future site operations and best practices to be adopted;
- Proposed capacity building for implementation of the proposed Environmental Management Plan by the client.

### **3.1 Environmental monitoring and management plan**

One of the key outputs of this study will be an environmental monitoring and management plan. It will indicate impact issues and effects, proposed mitigation measures, stakeholders involved in monitoring performance of developed mitigation measures, frequency of monitoring and costs involved.

### **3.2 EIA report content**

The consultant shall undertake the EIA, and will produce an Environmental Impact statement, which will have the following content:

1. An Executive Summary, stating the major findings of the study;
2. Background information on the substation, including location, operator, previous and planned extent and operations, planned infrastructure/installations and timing, safety provisions, methodology for undertaking this EIA study;
3. Site baseline bio-physical and sociological information, area infrastructure and activities in relation to project site and proposed redevelopment of the substation;
4. A review of policies, laws, regulations and standards, and the substation's conformance;
5. Public consultations and disclosure, mentioning stakeholder concerns and measures to address them;
6. Analysis of alternatives, including a comparison of feasible alternatives to the proposed project site, technology, design, and operation—in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements.
7. Recommendation of appropriate mitigation measures for all significant negative environmental impacts predicted;
8. Propose an environmental management and monitoring plan for negative impacts and assessing effectiveness of mitigation measures, and propose a budget for it;
9. Make recommendations and conclusions regarding future operations of the substation as an environmentally and economically sustainable project.

#### 4.0 ENVIRONMENTAL IMPACT ASSESSMENT TEAM COMPOSITION

The following Environmental Practitioners will undertake this EIA study.

1. Mr. Otim Moses – Team Leader/OHS and Environmental Systems Analysis
2. Mr. Kityo Peter: Natural Resources Management/Ecologist
3. Mr. David Nkuutu: Botanist/Land use mapping
4. Edith Kahubire: Sociologist

The above environmental practitioners will be supported by the following experts:

- Mr. Jude Kidega: Electrical Engineer
- Eng. Semuwemba James: Civil Engineer

## Appendix 2: List of persons consulted

Name	Institution/contact
Scovia Nakawuma 0782098785	Environment Officer, Kaliro District
Kasango William	Director Natural Resources
Anthony Lukwago, 0772601358	CAO, KDLG
Kagoda Elijah 0772612891	Chairman LC V, KDLG
Gabriel Fataki 0772988313	District Engineer, KDLG
Wancha Tom Francis - 0772587751	District Planner, KDLG
Mr. Kasadha John Stephen - 0772898966	Town Clerk Kaliro Town Council
Rose Tulirabirawo	Kaliro Town Council Engineer
Sebagabo Johnson	Environmental Health Officer- Kaliro Town council
Ekisa John Bird - 0712648883 Tidamulala Tom John - 0752870855 Omeri Emmanuel – 0753027837	Directors of Kaliro College Secondary School
Zowena Nkono,	LC1 Chairperson, Nakiyanja Zone, Kaliro Town Council
Lugwire James - 0752833485	Parish Chief, Namugongo.
Lydia Mpanja - 0774444168	Subcounty Chief, Namugongo subcounty.

**Appendix 3: Copy of letter from LC1**

**Appendix 4: List of Plant species encountered at the site and immediate neighbourhood**

<b>Family</b>	<b>Identification</b>	<b>Growth form</b>
Amaranthaceae	<i>Amaranthus spinosus</i>	Herb
Anacardiaceae	<i>Mangifera indica</i>	Tree
Apiaceae	<i>Centella asiatica</i>	Herb
Asteraceae	<i>Ageratum conyzoides</i>	Herb
Asteraceae	<i>Bidens pilosa</i>	Herb
Asteraceae	<i>Conyza floribunda</i>	Herb
Asteraceae	<i>Lactuca attenuata</i>	Herb
Asteraceae	<i>Vernonia amygdalina</i>	Shrub
Bignoniaceae	<i>Markbamia lutea</i>	Tree
Capparidaceae	<i>Cleome gynandra</i>	Herb
Caricaceae	<i>Carica papaya</i>	Tree
Cucurbitaceae	<i>Peponium vogeli</i>	Liana
Commelinaceae	<i>Commelina africana</i>	Herb
Commelinaceae	<i>Commelina benghalensis</i>	Herb
Convolvulaceae	<i>Hewittia scandens</i>	Liana
Cyperaceae	<i>Cyperus cyperoides</i>	Herb
Cyperaceae	<i>Cyperus latifolius</i>	Herb
Euphorbiaceae	<i>Euphorbia heterophyllus</i>	Herb
Euphorbiaceae	<i>Euphorbia Hirta</i>	Herb
Euphorbiaceae	<i>Phyllanthus amarus</i>	Herb
Euphorbiaceae	<i>Securinega virosa</i>	Shrub
Malvaceae	<i>Urena lobatum</i>	Shrub
Mimosaceae	<i>Mimosa pudica</i>	Herb
Moraceae	<i>Ficus brachypoda</i>	Tree
Moraceae	<i>Ficus exasperata</i>	Tree
Oxalidaceae	<i>Oxalis latifolia</i>	Herb
Papilionaceae	<i>Crotalaria brevidens</i>	Herb
Papilionaceae	<i>Indigofera drepanocarpa</i>	Herb
Poaceae	<i>Brachiaria ducambens</i>	Herb
Poaceae	<i>Cynadon dactylon</i>	Herb
Poaceae	<i>Eleusine indica</i>	Herb
Poaceae	<i>Panicum maximum</i>	Herb
Poaceae	<i>Paspalum scrobiculatum</i>	Herb
Poaceae	<i>Sporobolus Africana</i>	Herb
Poaceae	<i>Sporobolus pyramidalis</i>	Herb
Tiliaceae	<i>Corchorus fascicularis</i>	Herb

**Appendix 5: Copy of site lay out plans for electrical and civil works**

## Appendix 6: Site hydro-geological mapping report

By Cate Nimanya Z

## **Introduction**

In order to assess the types of soils in the subsurface, geophysical measurements were performed at randomly selected points within the proposed site. The geo-analyses performed were to identify the different soil types existing and the physical qualities of the soil types in Kaliro town

## **Location and Geography**

The site is located within Kaliro District one of the districts created from Kamuli. It is located in south eastern Uganda and borders the districts of Kamuli to the West and Jinja to the south , Iganga to the east and south east , Pallisa to the north east and Lira soroti and Kumi districts to the north. The site is located between Latitudes

The area has commercial and residential neighbourhood and is in the main town area. The current activities taking place at the site are, motor vehicle servicing and petty trade in foodstuffs.

### *Water Resources and Drainage pattern*

The water resources comprise open water bodies, permanent and seasonal wetlands/swamps streams and lakes surrounding the town. Kaliro town lies within the catchments downstream of Lake Victoria, discharging into Lake Kyoga. There are papyrus swamps in the wide aggraded major valleys with low rounded interfluves.

### *Geology*

The area is underlain mainly by two types of rock systems of the basement complex namely Cainozoic and Pre- Cambrian rocks. The Cainozoic rock system is mainly Pleistocene to recent rock material composed of sediments, alluvium, black soils and moraines. The Precambrian rock system is mainly wholly granitised or high to medium grade metamorphic formations, composed of undifferentiated gneisses including Aruan gneiss and Nyazian Kavirondian gneisses and post- Kavirodian granites.

### *Hydrogeological Environmet*

There are two aquifer zones namely the weathered rock often termed the regolith and the fractured bedrock. The regolith aquifer can store relatively large quantities of water; however, it often has rather limited water transmitting capability. The main storage is the more porous clayey saprolite or uppermost sandy collapsed zone. In the fractured aquifer, the degree of interconnection varies and the potential for groundwater depends on the interconnection. The water is found in the overburden and fractured zone

### *Groundwater Potential*

The presence of productive boreholes in the town indicates that there is fairly good groundwater potential. The boreholes records obtained from Entebbe WRMD, indicate yields ranging from 0.23 to 5m<sup>3</sup>/hr. The records show that a lot of water is struck in the fractured zone.

## Methodology

The work involved collecting and analysing all available data on the existing water sources in the village. Analysis was also extended to the neighbouring villages and parish level due to scarcity of data in the village where the site is located.

Field investigations involved studying topographic expressions lineaments, fractures and geology followed by detailed Hydrogeological and geophysical surveys at the site. The geophysical method used was “electrical resistivity” using an ABEM SAS 300C series Terrameter.

The soil types, their depths relative to each other and some of their physical properties have to be known in order to make a viable assessment of the site physical properties.

### ***Principle of Electrical Resistivity Method***

A direct current is sent through the ground between two metal electrodes. Since different earth layers offer resistance to the passage of current in varying degrees, some voltage loss will occur as the current flows from one electrode to another. The voltage loss is measured at potential electrodes placed between current electrodes. Conductivity of the current in the subsurface depends on the conductivity of rock/soil material, porosity as well as the volume of water in the pores. The presence of water and its chemical character are the principle controls on the flow of electric current because most rock particles offer high resistance to current flow. Resistivity decreases with increasing saturation and salinity of water in the pore.

This method provides information on the depth to aquifers, water tables, impermeable formations and bedrock within a layered sequence by vertical electrical sounding (VES) Vertical Electrical Soundings (VES) to a depth of 40m was chosen such that a representative soil profile can be generated, were performed at two points over the site. A stratigraphic column (soil profile) of the area was then generated

## Work done and Analysis of Measurements

One vertical electrical sounding was made at the site because the area is small and that sounding can suffice to provide an overall picture of the underneath of the site because it is too small such as to make even the slightest difference in geology.

### *VES 111(a)*

The original field data showed constant apparent Resistivity of the soil layers with depth to a depth of 4.4m, which is interpreted as top loamy soil, and then a gradual increase to a depth of 9.1m which shows laterites. A notably sharp decrease in apparent resistivity is experienced at a depth of 40m interpreting into the presence of groundwater and fractures. The formation varies from clay, phyllite, gravel, and weathered granite. The generated geological stratigraphy at that point is; Black top soil (0m – 6m), Lateritic clay (6 -9)m, clay and Phyllite (9 – 31m), weathered granite (31 – 37m), 37 – 70 m and above is bedrock of granite (figure 2).

The stratigraphic column is shown in figure 2 below.

Figure 26: Stratigraphy at the proposed site

## **Conclusion and recommendations**

The consultant carried out an in-depth hydro-geological study of the areas and the findings are well backed up by existing data in the sub county. It is on the basis of this that she has come up with the following recommendations

The site has a relatively thick deposit of clay with an average first water strike of 20m. Other water strikes are between 15 and 40m. The aquifer is characterised as weathered granite. It is recommended that the developer can excavate up to 15m because of the groundwater table being far from the surface. A discussion with the communities confirmed this as they do not strike water while constructing the latrines.

Excavations by UMEME Ltd will be to a depth of 1.5m. However provisions to trap waste oils should be put in place though the possibility of contamination of ground water is remote. Continuous monitoring is essential to ensure to avoid contamination of the water.