REPUBLIC OF UGANDA

MINISTRY OF WATER AND ENVIRONMENT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

FOR MATANDA IRRIGATION SCHEME TO BE LOCATED IN KANUNGU DISTRICT

VOLUME I

Prepared for:

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Project index

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TEAM

This Environmental and Social Impact Statement has been complied in accordance with Section 20(1) of the National Environment Act (NEA) and Environmental Impact Assessment (EIA) Regulations, 2020, in conformity with the National Environment (Conduct & Certification of Environmental Practitioners) Regulations, 2003, below are names of the Environmental Impact Assessors.

The Original ESIA report of 4420ha was done by AIR WATER EARTH(AWE)Ltd, and the additional 4580 ha was covered by a team of experts engaged by MWE following World Bank recommendation, extending the spatial scoped of the study to 9000 hectares. Whereas the dam is to serve total of 9000 Ha, the pipeline network distribution only covers 4420 Ha under the current design.

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ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
AEZ	Agro-Ecological Zones
AfDB:	African Development Bank
AIDS	Acquired Immune Deficiency Syndrome
AOI	Area of Influence
AWE:	Air Water Earth
BAP	Biodiversity Action Plan
BBM	Building Block Methodology
BINP	Bwindi Impenetrable National Park
BOD	Biochemical Oxygen Demand
CAO	Chief Administrative Officer
CBD	Convention on Biological Diversity
CDP:	Consultation Disclosure Plan
CFP	Chance Finds Procedure
CFR:	Central Forest Reserve
CH	Cultural Heritage
CHMP	Cultural Heritage Management Plan
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMP:	Catchment Management Plan
CO	Carbon monoxide
CO_2	Carbon dioxide
CSA	Community Supported Agriculture
CSEMS	Contractor's Site Environmental Management System
DAIMWAP	Department of Agricultural Infrastructure, Mechanization and Water for Agricultural Production
DAO	District Agricultural Officer
DC	Direct Current
DCDO	District Community Development Officer
DDP	District Development Plan
DE	District Engineer
DEO	District Environmental Officer
DHO	District Health Officer
DIA	Directly Influenced Areas
DLO	District Labour Officer
DMP	Dust Management Plan
DNRO	District Natural Resources Officer
DO	Dissolved Oxygen
DPO	District Production Officer
DRIFT	Downstream Response to Imposed Flows Transformation
DSAE	District Senior Agricultural Engineer
DSMP	Dam Safety Management Plan
DSP:	Dam Safety Plans
DWD:	Directorate of Water Development
DWO	District Water Officer

DWRM:	Directorate of Water Resources Management
EA	Environmental Assessment
EFR	Environmental Flow Regime
EHS	Environment, Health and Safety
EIS:	Environmental Impact Statement (or “EIA report”)
ELOHA	Ecological Limits of Hydrologic Alteration
EPT	Ephemeroptera, Plecoptera and Trichoptera
ERA:	Electricity Regulatory Authority
ERIMP	Emergency Response and Incident Management Plan
ESHSP	Environment Social, Health and Safety Plan
ESIA	Environmental & Social Impact Assessment
ESIRT	Environment and Social Incidents Response Toolkit
ESIS	Environmental and Social Impact Statement
ESMF	Environmental and Social Management Framework
ESMMP	Environmental and Social Management and Monitoring Plan
ESMP	Environmental and Social Management Plans
FAO	Food and Agriculture Organization
FAO:	Food and Agriculture Organization
FBI	Family Level Biological Indices
FDC	Flow Duration Curve
FFS	Farmer Field School
FGD	Focus Group Discussion
FRL	Full Reservoir Level
FSL:	Full Supply Level
FTF:	Farmers Task Force
FTFC	Farmers Task Force Committees
GAP_S	Good Agricultural Practices
GBV	Gender Based Violence
GIS	Geographical Information System
GMP	Grievance Management Plan
GoU	Government of Uganda
GPS	Global Positioning System
HC	Health Centre (e.g. HC I, II, III, IV)
HIV	Human immune Virus
I&APs	interested and affected persons
ICH	Intangible Cultural Heritage
ICOLD	International Commission on Large Dams
ICRP	Irrigation for Climate Resilience Project
IFC	International Finance Corporation
IFM	Instream Flow Incremental methodology
IFR	Instream Flow Requirement
ILO	International Labour Organization
IP:	Indigenous People
IPMP:	Integrated Pest Management Plan

KADI:	Kanungu Development Initiative
KDLG	Kanungu District Local Government
KDMISTSC:	Kanungu District Matanda Irrigation Scheme Technical Subcommittee
KIIs	key informant interviews
LADA:	Literacy Action Development Agency
LC:	Local Council (used for various tiers of local councils e.g. LC 1, 2, 3, 4 or 5 or I, II, III, IV, V)
LG	Local Government
LMP	Labour Management Plan
LULC	Land Use and Land Cover
MAAIF:	Ministry of Agriculture, Animal Industry and Fishers
MCM	Million Cubic Meters
MGLSD	Ministry of Gender, Labour and Social Development
MoH:	Ministry of Health
MTWA	Ministry of Tourism wildlife and antiquities
MTWA	Ministry of Tourism wildlife and antiquities
MWE	Ministry of Water and Environment
MWL	Maximum Water Level
NARL	National Agricultural Research Laboratories
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEMA	National Environment Management Authority
NFA:	National Forestry Authority
NGO:	Non-Governmental Organization
NHP	National Health Policy
NIP	National Implementation Plan
NKKD:	North Kigezi and Kinkizi Diocese
NMP	Noise Management Plan
NOF	Non-Overflow
NOx:	Oxides of nitrogen
O&M	Operations and Maintenance
OHS	Occupational Health and Safety
OP:	Operational Procedure
PAP:	Project Affected Person
PCR	Physical Cultural Resources
PCR:	Physical Cultural Resources
PGA	Peak Ground Accleration
PH:	Public Health
PIU:	Project Implentation Unit
PM:	Particulate matter (e.g., PM10, PM5, PM2.5)
POPs	persistent organic pollutants
PPE	Personal Protective Equipment
PPV	Particle Displacement Velocity
PS	Performance Standard
PSO	Private Scheme Operator
PST	Project Support Team

PV	Photovoltaic
QENP	Queen Elizabeth National Park
RAP:	Resettlement Action Plan
REA:	Rural Electrification Agency
RoW:	Right of Way
SAICM	Strategic Approach to International Chemicals Management
SAS	Subcounty Chief (Senior Assistant Secretary)
SCHM	Senior Cultural Heritage Monitor
SDG	Sustainable Development Goal
SE	Supervising Engineer
SECMP	Soil Erosion Control Management Plan
SMP	Spill Management Plan
SOx:	Oxides of Sulphur
STD	Sexually Transmitted Diseases
TBL	Top Bund Level
TC	Town Clerk
TMP	Traffic Management Plan
TOR	Terms of reference
TSP	Total Suspended Particulates
TSS	Total suspended solids
UBOS	Uganda Bureau of Statistics
UN	United Nations
UNBS	Uganda National Bureau of Standards
UNFCCC	United Nations Framework Convention on Climate change
UNMA	Uganda National Metrological Authority
UWA:	Uganda Wildlife Authority
VAC	ventilation and air conditioning systems
VAC	Violence against Children
VEC	Valued Environmental and Social Component
VHTs	Village Health Teams
VIP	Ventilated Improved Pit-latrine
VMG	Vulnerable and Marginalized Group
VMGF	Vulnerable and Marginalized Groups' Framework
VMGP	Vulnerable and Marginalised Groups' Plan
WB:	World Bank
WBS	World Bank Safeguards
WCD	World Commission of Dams
WfP:	Water for Production
WMP	Waste Management Plan
WSSB	Water Supply and Sanitation Board
WUA	Weighted Usable Area
WUC	Water User Committees
ZOI	Zone of Influence

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

01. Background

The Government of Uganda through the Ministry of Water and Environment (MWE) with support from the World Bank is implementing the Irrigation for Climate Resilience Project (ICRP, World Bank project code P163836). The project development objectives are to provide farmers in the project areas with access to irrigation and other agricultural services, and to establish management arrangements for irrigation service delivery. Specifically, the project will contribute to improvement of farm incomes, rural livelihoods, food security, and climate resilience, sustainable natural resources management in the proposed area of Matanda Irrigation scheme in Kanungu District.

Box 0-1: The Project comprises three components here listed:

The project has three components:
Component 1. Irrigation Services (US$120 million). Access to irrigation is critical to allowing farmers cope with climate variability, to increase yield and intensification, and diversify towards higher value crops. Component 1 aims at providing farmers with irrigation water across various irrigation models, classified around the size of irrigation development [1] as per the National Irrigation Policy, spanning across the country. Component 1 comprises three sub-components.

- *Sub-component 1.1 on Large and Medium-scale Irrigation.*
- *Sub-component 1.2 on Small and Micro-scale Irrigation.*
- *Sub-component 1.3 on Integrated Catchment management.*

Component 2. Support services for agricultural production and value-chain development (US$32.6 million)
Component 2 aims to support farmers carrying out on-farm irrigation, accessing production and value addition knowledge and skills, and developing sustainable market access. The project will support farmers in increasing their knowledge using a Farmer Field School (FFS) approach, increased access to inputs (improved seeds, fertilizers), on-farm irrigation technologies, machineries, and postharvest and agro-processing infrastructures through the use of smart subsidies and consultancy services. Component 2 comprises two sub-components:

- *Sub-component 2.1 on On-farm Production and Productivity.*
- *Sub-component 2.2 on Value Addition and Market Linkages*

Component 3. Institutional Strengthening and Implementation Support (US$10 million)
Component 3 comprises two sub-components:

- *Sub-component 3.1 on Institutional Strengthening.*
- *Sub-component 3.2 on Implementation Support.*

Box 0-1B: Physical Progress of Kabuyanda Irrigation Scheme:

There are two (2) works contracts that are being implemented under the Kabuyanda Irrigation Scheme:

(i) Kabuyanda Dam Works

(ii) Irrigation Pipe Network. Support services for agricultural production and value-chain development

Box 0-1C: E&S Performance of Kabuyanda Irrigation Scheme:

Below is the summary of the E&S Performance of Kabuyanda Irrigation Scheme:

Key achievements under safeguards management.

i. The Ministry of Water and Environment (MoWE) has a dedicated safeguards team including the Environmental Specialist, Social Safeguards Specialist, Sociologists and Environmental Officers to supervise E&S aspects of Kabuyanda Irrigation Scheme.
ii. The Resident Engineer has also deployed Environmental Expert and Social Development Expert at site to undertake daily supervision and enforcement of E&S requirements of the contracts.
iii. The Contractors have hired and deployed qualified and competent Environmentalists, Sociologists,Health and Safety Officers, Doctors-on-Call and Site Nurses headed by the Project Managers to implement the E&S plans at site.
iv. The Contractors have prepared and are now implementing the Contractor's Environmental and Social Management Plans (C-ESMPs) that were reviewed and cleared by the World Bank.
v. Bi-weekly safeguards implementation progress review meetings are held with the Dam and Irrigation network contractors. These meetings are attended by the Contractors, Resident Engineer, Third Party Safegaurds Monitoring and Supervision Consultant and the Ministry of Water and Environment staff.
vi. The Ministry of Water and Environment (MoWE) undertakes quarterly E&S Safeguards Implementation Support Clinics for both the Dam and pipe network contractor in which contractors undergo hands-on training on E&S requirements, implementation and record keeping.
vii. Implementation of Priority catchment management measures will commence by October 2024
viii. Restoration of 1,000 Hectares of Rwoho Central Forest Reserve to mitigate the 100.2 Ha severed by Kabuyanda Dam works has been completed.

Other Technical Assistance (TAs) Consultancies under E&S

MoWE has also hired and deployed the following TA to enhance safeguards compliance;

- Gender Based Violence/Violence Against Children (GBV/VAC) Consultancy Firm
- HIV/AIDS Consultancy Firm
- Grievance management and Stakeholder Engagement Consultancy Firm

The above firms support MoWE in sensitizing contractors' workers, communities and local authorities on social safeguards risks and mitigation measures in line with their contractual obligations.

Third Party E&S Safeguards Supervision and Monitoring

The Ministry of Water and Environment (MoWE) awarded the contract for Environmental and Social safeguards supervision and monitoring to JBN Planners and Consults that became effective in April 17, 2023. This contract will cover the construction and defects liability period (DLP) of the Kabuyanda Iirrigation Scheme works. JBN has undertakes the following;

- Supported MoWE in the review of the Contractor's Environmental and Social Management Plans (C-ESMPs) prior to clearance by the World Bank.
- Revieweved the screening, scoping and ESIA reports for the Contractors' auxiliary sites such as workers' camps, material borrow sites and batching plants prior to approval by the National Environment Management Authority.
- Undertakes impromptu, monthly and quarterly site inspections and prepares reports thereof.
- Attends monthly site meetings and other safeguards meetings organized by MoWE.
- Undertakes independent water quality tests, biodiversity assessments and stakeholder engagements to ascertain the compliance of the Contractors to E&S requirements.

World Bank Rating of E&S Performance of Kabuyanda Irrigation Scheme

The World Bank Project Implementation Support Mission of March 2024 rated the E&S performance of Kabuyanda Irrigation Scheme as **Satisfactory**.

02. Project Developers details

Project developer	Water for Production (WfP) Department Ministry of Water & Environment (MWE) Plot 11/28 Port Bell Road – Luzira P.O. Box 20026, Kampala
Contact person	Permanent Secretary- Ministry of Water and Environment
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03. Project Location

Matanda irrigation scheme will be located in southwestern part of Uganda, in Kanungu District, Kinkizi, Nyamirama, Nyanga Sub counties, Kihihi Town Council, Kihihi Sub County on the left-hand side and Nyakinoni Sub County on the right-hand side. The irrigation system will impound Kiruruma River waters with the dam and reservoir in Nyakutuguru Parish on the left side and Karubezi Parish on the right side. The proposed command area of the scheme is 9000 ha.

04. Project Description

The Dam for Matanda scheme is located on river Kiruruma, the proposed intake point for Matanda irrigation scheme drains a catchment area of approximately 137.9 km^2.The area stretches through the sub-counties of Kanungu TC, Rutenga, Rugyeyo, Kirima, Kanyantorogo, Kambuga and Katete. It comprises a number of small tributaries that join to form River Kiruruma. The proposed project consists of a Roller Compacted Concrete (RCC) dam, 32m high from foundation level creating a reservoir with storage capacity of 22.7 MCM to serve a total irrigation command area of 9000 hectares. Part of the irrigation command area borders the Queen Elizabeth National Park covering a stretch of 15km. An electric fence is under construction by UWA covering the Queen Elizabeth National Park boundary to protect the wildlife from the command area. It is the responsibility of the Uganda Wildlife Authority (UWA) to construct the current 15 km and the remaining 46 km of the electric fence.

05. Seismology

Seismic/Dynamic analysis was considered in the design of the dam to determine the response of the dam to seismic forces. Simulations for earthquakes were done and the dynamic response of the dam structure determined. This response includes displacements, and both tensile and compressive stresses.

Return Period for Seismic Analysis: According to current practice large dams have to be able to withstand the effects of the Maximum Design Earthquake (MDE) and the Probable Maximum Flood (PMF). These are the most severe events that could affect the safety of a dam, and they are considered to have a return period of several thousand years. Matanda was designed for PMF >10,000-year floods. The value of the return period corresponding to the respective peak ground acceleration (PGA) was obtained from Cheriberi & Yee

(2022). For the Matanda dam site, the MDE-PGA = 0.15g used is associated with 10% exceedance probability for 50 years. The hazard potential for the proposed dam is related to its location upstream of Kihihi Town. The current hazard potential is low because the town is far from the river course and is at higher elevation compared to the river valley.

06. Soil Surveys for Irrigation Development

Soil survey was conducted to contribute to the understanding of the physical, chemical, and morphological characteristics of soils in Matanda, Kanungu district for irrigation development in order to improve crop production. The survey was conducted from 3rd - 13th November 2018. Complimentary soil surveys shall be undertaken as part of the agronomy extension services prior to commissioning of the scheme to ensure that the beneficiary farmers access initial soil analysis of their parcel(s) as part of the initial capacity building on improved productive practices.

Haplic Ferralsols and Acric Ferralsols were highly suitable for irrigation with no major limitation and Rhodic Ferralsols showed moderate suitability with limitation due to textural class S2(t). Very high and low values of Ksat are not favorable for irrigation. The high values can lead to a loss in water due to percolation and the low values can result in huge volumes of runoff and erosion. Ksat is an important soil property to many soil water-related investigations such as water conservation, irrigation design, drainage and general transport phenomena in soils. Ferralsols have high structural stability. The relatively low Ksat can be attributed to the formation of stable micro-aggregates. The topsoil macro-aggregates can be subjected to degradation due to human activities such as tilling which decreases Ksat.

Arenosols (Humic) S3(t,ks), Gleyic vertisols S3(t,ks), Fluvisols S3(t,) were also marginally suitable and Gleyic Planosols N1(sd,S) is marginally Not suitable. The first two soils; Arenosols (Humic) and Gleyic vertisols S3(t,ks), had a soil texture and Ksat limitation. On the same note; Fluvisols S3(t) had limitation due to texture S3(t,) while Gleyic Planosols N1(sd,S) was limited due soil depth (sd) and slope(S). Texture determines the rate at which water shall be applied, how much shall be applied and how often irrigation shall occur. For the case of Gleyic Vertisols which contains much more clay than other soil types, water will infiltrate slowly and applying large volumes quickly will lead to a runoff. However, they can store a large volume of water and therefore requires less frequent irrigation. Good soil structure allows for improved infiltration and drainage. It also enhances root growth. Poor structure reduces infiltration and water holding capacity and will make irrigation more difficult to manage.

Leptosols are Not suitable due to a soil depth limitation (sd). Soil depth determines the potential rooting depth of plants to be grown and any restrictions within the soil that may hinder rooting depth. Any discontinuities in the soil from layers of sand, gravel or even bedrock physically limit rooting depth and hinder irrigation. It can also create problems when using irrigation.

Soil nutrient status of the project site is varied from point to point and depth to depth as expected. N showed 50% of the sample having moderate values and 40% low levels of N and the remaining 10% high in N content. The soils are low in available P with almost 80% of the samples below the critical values and the remaining 20% ranging between medium-high levels of P in the soils. K levels in the soil range from very low to medium. In exception of few cases; the level of Ca in the soils is moderate/medium. For increased and sustainable crop yields supplementary nitrogen and phosphorus fertilizer and organic manures might be required with the experience of other irrigation schemes in Uganda.

Supplying of optimum quantities of nutrient N, P and K with farmyard manure have beneficial effects on the physical and biological situations of the soils. In order to manage & maintain soil fertility in the project area, organic manure and inorganic fertilizers shall be utilized together. The application of nitrite-containing fertilizers for crops grown under surface irrigated agriculture and water-logged soils results in a considerable amount loss of N due to its denitrification. Therefore, nitrogen fertilizers must be given a split application depending on the critical growth stage of the crop. Application of green-manure increases utilization of phosphorus by the crop not from the added fertilizers but also from the reserve supplies of soil phosphorus. The application of organic matter also improves the CEC of the soil.

07. Agro-Economic Feasibility of Matanda Irrigation Scheme

The farmers in Matanda practice subsistence agriculture. For Matanda, the main typologies are Rice, Cereal/Legume (Field Crops), and Coffee/Banana dominated fields. Land tenure system is mainly customary in both schemes across all typologies. In Matanda, the percentages of farmers with customary land are 79.2%, 75.9%, and 71.8% for rice, cereals and perennials.

The major crops grown by the farmers in the command area include rice, maize, beans, groundnuts, millet, coffee, and banana. Besides, sweetpotato, cassava, tomatoes, watermelon, cabbages and sugarcanes are also grown but by very few farmers. Both crop rotation and intercropping are dominant cultural practices applied in Matanda and across the different farm typologies. Nevertheless, the cropping pattern is sometimes not well sequenced as in some cases, crops in the same family are intercropped or rotated following each other such as beans with groundnuts. Consequently, farmers do not generally enjoy the benefits of intercropping and crop rotation.

Overall, the cropping calendars for the crops grown follow the rainfall regimes in Matanda. However, these calendars reveal poor adoption of Good Agronomic Practices (GAPs). For instance, they are characterized with: weeding only once in the entire crop production cycle; rarely are pests and disease managed; there is very limited use of productivity enhancing technologies particularly fertilizers; and although improved seed is used, most of it is recycled from the previous season.

08. Scope of the Technical Works

Table ES 1: Design components

Scenario	Environmental Flow	FRL (m)	Storage @ FRL (MCM)	MDDL (m)	Storage @ MDDL (MCM)	Deepest Bed Level (m)	Height of Dam at FRL (m)	Free Board (m)	Total Dam Height (m)	Command Area (Ha)
A	0.435 m^3/s	+1265.0	14.835	+1127	0.724	+1111.86	43.14	3	46.14	9000
B	**0.435m^3/s**	**+1270.51**	**22.7**	**+1265.0**	**0.724**	**+1246.5**	**25.0**	**4**	**32.00**	**9000**
C	0.435 m^3/s	+1137.00	3.247	+1130	1.277	+1111.86	25.14	3	28.14	9000

The scope of the technical works for the proposed irrigation scheme has been categorized into three phases, including; Design and Planning, Construction, and Operation phase**.**

Table ES 2 (a): Project phasing activities

Phase	Description phase pointers	
Design and planning phase	Scheme Dam	a) Catchment Area Characteristics b) Diversion Works

Phase	Description phase pointers	
		c) Dam geometric design d) Reservoir e) Outlet works f) Spillway and Non-Overflow Dam g) Galleries h) Instrumentation in Concrete gravity dams
	Irrigation Network Design	a) Cropping Pattern b) Crop Calendar c) Command area irrigation method; Drip/Sprinkler/Flexible hose pipe d) Irrigation system design e) Pipe material adopted in Matanda irrigation scheme f) Valves adopted in Matanda irrigation scheme
Pre-Construction phase	a) Mobilisation of Project Team b) Development of plans and obtaining of required permits c) Land surveys d) Land acquisition e) Acquisition of construction equipment and materials f) Site clearance g) Construction of access roads or improvement of existing roads h) Construction of Contractors camp i) Transportation of construction material and equipment to the project sites	
Construction phase	During the construction phase, the dam (super structure, spillway, intake and bottom outlet), irrigation networks (primary, secondary and tertiary distribution lines), and axillary components (electrical and mechanical) will be put in place. The construction phase is projected to take a period of five years. This will be followed by decommissioning of all project structures not required during the operation phase of the Project, including workshop structures and workers' camps, which will be demolished, and the debris disposed of in a legally acceptable manner. Restoration of borrow pits and dumpsites shall be undertaken to bring them back to as close to their original environmental scenary as possible	
Operation Phase	The operation phase of this project basically refers to the time after construction activities have ended and water from River Kiruruma is being supplied to 199No. blocks in the 4420-ha command area for irrigation. The additional 4580 ha is expected to cover more 207 blocks bringing a total number of blocks to 406 in the 9000ha. Whereas the dam is to serve total of 9000 Ha, the pipeline network distribution only covers 4420 Ha under the current design. Periodical maintenance is planned to be done at a certain interval, after harvest season or before planting season.	
Decommissioning Phase	Upon the project life cycle of 50 years in reference to detailed design report, the scheme shall be decommissioned. Restoration of project sites shall be undertaken to bring them back to as close to their original environmental scenary as possible. The auxiliary sites thata will be decommissioned and restored after use, and all, by the construction period include; workers' camp and materials storage yard, sand mine, gravel borrow pit, stone quarry, batching plant and clay borrow site.	

Project alternatives (*according to the feasibility study report*)

The updated ESIA was conducted during both the dry and wet seasons in the months of June – July 2023 and September – October 2023 respectively. However, the exact time for approvals by the World Bank and

NEMA and the associated processes of procurement, deployment of the contractor, and commencement of construction and defects liability and operation and maintanance are not yet certain.

Table ES 2 (b): Phasing of feasibility and ESIA studies

Feasibility study stage	Command area	Scenarios
Inception phase (November 2018)	4750 ha	
Interim Report (July 2019)	690 ha – 4750 ha	11 scenarios
Draft Feasibility Study Report (October 2019)	2180 ha – 4700 ha	5 scenarios
Detailed Feasibility Study Report (December 2019)	4420 ha	3 scenarios (A, B, & C)
Adopted by ESIA (May 2022)	4420 ha	Scenario B
Field work (June-July 2023)	**4580**	**Scenario B**
Field work (September-October 2023)	**4580**	**Scenario B**
Updated ESIA (November 2023)	**9000ha**	**Scenario B**

09. Scope of the ESIA

This Environmental and Social Impact Assessment was aimed at developing an Environmental and Social Management and Monitoring Plan (ESMMP) to guide the construction and operation of Matanda Irrigation Scheme proposed to be located in Kanungu District, having established both environmental and social baseline, identified and assessed the potential environmental and social impacts of the proposed project with a view of eliminating/minimizing the negative impacts prior to, during and after project implementation while enhancing the positive impacts. These objectives are intended to ensure that development and implementation of the proposed project is without adverse socio-environmental effects, complies with national regulations and environmental and social requirements and the relevant World Bank Operational Policies of environmental and social safeguards.

10. Policy, Legal and Institutional Framework

The policy, legal and institutional framework relevant to the proposed project and to which it shall comply have been cited. National polices and legislative framework, financial institution's safeguard policies, as well as international agreements and conventions to which Uganda is a party are also discussed. Relevant permits which ensure compliancy during construction phase and road operations have been cited.

Table ES 3: Applicable Uganda Legal Framework

Applicable Uganda Legal Framework	Relevancy to the construction and operation of Matanda irrigation scheme
Applicable Ugandan Policies	
National Environment Management Policy, 1994	The overall goal of this policy is the promotion of sustainable economic and social development, mindful of the needs for future generations. The management and monitoring plans developed because of the findings of this study will serve for sustainability of the scheme.
Uganda National Land Policy, 2013	The overall goal of the Policy is to ensure an efficient, equitable and optimal utilization and management of Uganda's land resources for poverty reduction, wealth creation and overall socio-economic development, hence the ESIA and RAP study.
National Gender Policy, 2007	The goal of this policy is to mainstream gender issues in the national development process, particularly women. A gender management plan to guide women inclusion and equal employment opportunity is recommended to be developed by the project contractor. The policy also identifies Gender Department under Ministry of Gender, Labour and Social Development (MGLSD) as a key project stakeholder.
National Water Policy, 1997	The goal of this policy is to provide guidance on development and management of the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs, with full participation of all stakeholders and mindful of the needs of future generations.
Occupational Health and Safety (OHS) Policy, 2017	This policy calls for scheme labour conditions safeguards such as, the contractor bearing an Occupation, Safety & Health Management Plan, Emergency Response and Incident Management Plan, Induction of all workers, toolbox meetings, and PPE usage.
National AIDS Policy, 2004	It is anticipated that the project will employ people from different parts of the country, indiscriminate of their HIV/AIDS status. Interaction with the community may result in an increase in the spread of the disease. Measures shall therefore be instituted by the contractor and supervising agencies to ensure that the spread of HIV/AIDs is controlled through activities like sensitization of the workers and communities and providing free counselling and testing services among other measures.
Environment Health Policy, 2005	The Environmental Health policy will guide implementation of public health and hygiene intervention measures on the project.
National Irrigation Policy, 2018	The proposed scheme is aimed at promoting Integrated Water Resources Management approach in irrigation planning, development and management through ensuring reliable water for irrigation to optimize, intensify and diversify crop production and productivity as per policy objectives. The policy recognises Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) as a key project stakeholder.

National Sanitation Policy, 1997	The Goal of this policy is to promote and preserve the health of the community through improved sanitation. The policy will guide implementation of good sanitary intervention measures on the project, mainly for the construction crew.
Uganda National Culture Policy, 2006	The policy delineates the cultural heritage of Uganda as artistic and cultural expressions. Consultation of the Batwa leaving the project command area, were enacted by this policy delineation of the tribe as an Indigenous Community. The policy also identified Department of culture under MGLSD as a key project stakeholder.
Uganda National Climate Change Policy, 2012	Sector-Specific priorities for Agriculture and Livestock, irrigation systems that use water sustainably for irrigated agriculture such as this project, are encouraged to promote climate change adaptation strategies that enhance resilient, productive and sustainable agricultural systems in Uganda. Therefore, appropriate mitigation measures and irrigation monitoring strategies were devised under the ESMMP to achieve the overreaching and specific objectives of this policy.
National Agricultural Policy, 2013	This project seeks to support farming communities in Matanda by improving agricultural productivity, food security and livelihoods through irrigation aimed at achieving policy objective; achieving food and nutrition security and improve household incomes through coordinated interventions that focus on enhancing sustainable agricultural productivity. The same policy defines Ministry of Agriculture Animal Industry and Fisheries (MAAIF) as a key stakeholder for this project.
The National Fisheries Policy, 2004	The Overall fisheries sector goal is to ensure increased and sustainable fish production and utilization by properly managing capture fisheries, promoting aquaculture, and reducing post-harvest losses, specifically in River Kiruruma.
National Legislative Framework	
Constitution of the Republic of Uganda, 1995	The Constitution provides for inter alia, matters pertaining to land, natural resources such as rivers and lakes and the environment. It obliges citizens to maintain a clean and healthy environment. This ESIA is to ensure the project maintains a clean and healthy environment in its setting and the environs.
National Environment Act, No 5 of 2019	This Act established principles for sound environmental management and provides an Institutional Framework for environmental management as well as ESIA process for projects listed in its Fourth and Fifth Schedules (such as National Water Resources Management Programs - NWRMP ESIA process, contained in EIA guidelines for Water Resources Related Projects in Uganda, Sept. 2011, MWE). According to Schedule Five of the National Environment No.5 of Act 2019, a detailed ESIA for this project is required to be submitted to the Authority (NEMA) on basis of; **Category 4**: Utilisation of water resources and water supply; (a) Abstraction or utilisation of surface water for agricultural, industrial, or urban use of more than 21.709 MCM. Matanda scheme is planned to abstract 21.709 MCM. (c) Diversion of water from a river or stream, where the water discharged is more than 400 m^3/day or 30% of Internal Renewable Water Resources over the river catchment. Matanda scheme is planned to divert 21.709 MCM from River Kiruruma. **Category 6**: Agricultural investments, livestock, range management and fisheries; (d) Large scale irrigation of more than 20 hectares. The command area extent of this scheme is 9000Ha.
Land Act, Cap 227, 1998	Section 44 implores landowners to use land in compliance with several laws governing environmental, forestry amongst others. The proposed scheme command area is proposed to cover over 4420 Ha which is under jurisdiction of Kanungu District; Kihiihi, Kihiihi Tc, Nyakinoni, Nyamirama, Nyanga, and Kanyantorogo sub counties and villages, identified also as key stakeholders to the project under this Act's. Whereas the dam is to serve total of 9000 Ha, the pipeline network distribution only covers 4420 Ha under the current design.

Survey Act, 1964	During conduct of the Resettlement Action Plan for the proposed scheme, this Act will guide the adopted detailed survey methodology.
National Agricultural Advisory Services Act, 2001	This Act provides for the establishment of the National Agricultural Advisory Services (NAADS), which will provide and regulate provision of advice and information services to farmers by the local district administrative authority specifically the agricultural department
Seeds and Plant Act, 2006	During operation of the scheme, new seed varieties and breeds characterised with pest resistance, high quality, low-costs, hybrid, are anticipated to be introduced, of which need to meet set seed certification standards enacted by this Act through National Seed Certification Services Committee (NSCSC).
Agricultural Chemicals (Control Act) 2006	This Act provides for control and regulation of the manufacture, storage, distribution and trade in, use, importation and exportation of, agricultural chemicals that may be utilized during scheme operation phase.
Local Governments Act Cap 243, 1997	According to Section 9 of the Local Government Act, a local government is the highest political and administrative authority in its area of jurisdiction. The 4420 Ha proposed scheme command area is under jurisdiction of Kanungu District: Kihiihi, Nyamirama, Nyakinoni, and Kihiihi Tc sub counties and villages.
Physical Planning Act, 2020	Clause 32 of the Physical Planning Act required MWE to use services of a qualified designer engineer (Aarvee associates) to prepare the scheme design from feasibility study and conform to planning requirements prescribed by the district planning committee, Agricultural and the water office.
Employment Act, 2006	Is a framework Act which provides for matters governing individual employment relationships in terms of circumstances of provision of labor. Also, the Employment Act provides for matters of grievance settlement and issues of payment of wages and salaries.
Children's Act, Cap 59, 2016	The Children's Act was enacted; to reform and consolidate the law relating to children, Section 8 of this Act provides that no child will be employed or engaged in any activity that may be harmful to his or her health, education or mental, physical or moral development. The contractor will confirm the age of potential labourers prior to hiring through National Identity Card, birth certificate or confirming with LC.
Penal Code Act, Cap 120, 2007	It's upon the Penal Code Act that the code of conduct guidelines intended to establish and clarify the standards for behaviour in the contractor's company under this project will be developed.
Occupation Safety and Health Act, 2006	The Act, Section 13, puts the responsibility of protection of the worker and the general environment to the employer (project contractor) and he or she must take all measures to protect the worker and the general public from the dangerous aspects of his or her undertaking at his or her own cost. In onus for creation of a safe working environment and reduced health risk during construction phase, the contractor shall formulate an Environmental, Social, Health, and Safety (ESHS) plan and acquisition of a work registration permit from Department of Occupational, Health and Safety (OHS) in the Ministry of Gender, Labour and Social Development.
Public Health Act Cap 281-2000	Section 7 of this Act provides local authorities with administrative powers to take all lawful, necessary and reasonably practicable measures for preventing the occurrence of, or for dealing with any outbreak or prevalence of, any infectious, communicable or preventable disease such as COVID19, to safeguard and promote the public health in the command area.
Water Act, Cap 152, 1997	The objective of the Act is to enable equitable and sustainable management, use, and protection of water resources of Uganda through supervision and coordination of public and private activities that may impact water quantity and quality, such as proposed project abstraction of water from River Kiruruma. It also identifies the Directorate of Water Resources Management (DWRM) as a key project stakeholder.

Museums and Monuments 2023	This Act provides for the preservation and protection of historical monuments and objects of archaeological pale-ontological ethnographical and traditional interests through a chance finds procedure. The same act defines the Department of Museum and Monuments under the Ministry of Tourism wildlife and antiquities (MTWA) as a key project stakeholder.
Workers' Compensation Act, 2000	This Act provides for the compensation to be paid to a worker who has been injured or acquired an occupational disease or harmed in any way in the course of his work. It also identifies the OHS Department under the Ministry of Gender, Labour and Social Development (MGLSD) as a key project stakeholder.
Uganda Wildlife Act, 2019	An Act to provide for the conservation and sustainable management of wildlife; to strengthen wildlife conservation and management; to continue the existence of the Uganda Wildlife Authority; to streamline the roles and responsibilities of institutions involved in wildlife conservation and management; to continue the existence of the Wildlife Fund; to repeal the Uganda Wildlife Act, Cap. 200 and for related matters. Such as the wildlife in the neighbouring queen Elizabeth National Park.
National Forestry and tree planting Act, 2003	This Act provides for conservation, sustainable management and development of forests for the benefitof the people of Uganda; to provide for the declaration of forests reserves for the purposes of protection and production of forests and forest produce; to provide for the sustainable use of forest resources and the enhancement of the productive capacity of forests; to provide for the promotion of tree planting; to consolidate the law relating to the forest sector and trade in forest produce; to establish a National Forestry Authority; to repeal the Forests Act Cap.246 and the Timber (Export) Act Cap.247 and for related matter.
Land acquisition Act, 2013	An Act to make provision for the compulsory acquisition of land for public purposes and for matters incidental thereto and connected therewith. This applies to land acquisition process in the command area extent of the project area.
Explosive Act, 1936	An Act relating to the manufacture, storage, sale, transport, importation, exportation, and use of explosives. This Act guides contractors who may use explosives during construction on the transport, storage and use of the same.
National Social Security Fund (Ammended) Act, 2021	An Act to amend the National Social Security Fund Act, Cap. 222; to establish a stakeholder board; to provide for mandatory contributions by all workers, regardless of the size of the enterprise or number of employees; to provide for voluntary contributions to the fund; to provide for midterm access to member's contributions; to provide for a fve year term of offce for the managing director and deputy managing director; to empower the Board to use in-house expertise and fund managers in the investments of scheme funds; to empower the board to introduce new benefits in consultation with the Minister; and for related matters.This Act will guide the contractor of the project on the enumerations of the workers.
Uganda Citizen and Migration Control (Ammended) Act, 2009	An Act to make provision for acquisition of citizenship of Uganda pursuant to the Constitution, to provide for the compulsory registration of all Ugandans and the issue of national identification numbers and the issue of national identity cards to citizens of Uganda; to regulate the issue of passports to citizens of Uganda, to provide for the regulation and control of aliens in Uganda; to repeal the Uganda Citizenship Act, the Immigration Act, the Passports Act and the Aliens (Registration and Control) Act; and to provide for other matters incidental or connected with the foregoing. This Act will guide incase there are expertriates to work on the project.
Labour disputes (arbitration and settlement) act, 2020	An Act to amend the Labour Disputes (Arbitration and Settlement) Act,2006 to provide for the official seal ofthe Industrial Courtl to amend the composition of the Industrial Court and to provide for the powers of the Industrial Court; to provide for the terms and conditions of appointment of the Head Judge and other Judges of the Industrial Court to be similar to those of the Judges of the High Court; to provide for appointment of Registrar, Deputy Registrar and Assistant Registrar and for other related matters. This act will offer guidance incase of disputes on the project.

Tobbacco Act, 2015	An Act to control the demand for the consumption of tobacco and its products, to control the supply of tobacco and its products to the population; to protect the environment from the effects of tobacco production and consumption and exposure to tobacco smoke; to promote the health of persons and reduce tobacco related illnesses and deaths; to protect persons from the socioeconomic effects of tobacco production and consumption; to promote research, surveillance and exchange of information on tobacco control; to insulate tobacco control policies, laws and programs from interference by the tobacco industry; to strengthen coordination, partnerships and collaboration for tobacco control; to establish the Tobacco Control Committee; to fulfil Uganda's obligation and commitment as a party to the World Health Organisation Framework Convention on Tobacco Control (WHO FCTC) and to provide for other related matters. This act guides on specific places to smoke in during works on the project.
Anti Homosexuality Act, 2023	The Act to prohibit any form of sexual relations between persons of the same sex; to prohibit the promotion or recognition of sexual relations between persons of the same sex; and for related matters. The policy guides projects implementers on homosexuality and related practices and associated offenses and penalities. Following the World Bank Group's communication of its concerns with the enactment of the Anti Homosexuality Act (AHA), the Government of Uganda issued five Circulars (see Annex 9). Of particular importance is the Circular on Uganda's Social Safeguard Policies issued on September 21, 2023, by the Ministry of Finance, Planning and Economic Development, to all Accounting Officers, Ministries, Departments and Agencies and Local Governments, which states that: • "All World Bank-financed projects must be implemented in a manner consistent with the principles of non-discrimination as provided Article 21 of the Constitution of the Republic of Uganda. These projects shall also be implemented in accordance with World Bank policies and applicable Legal Agreements. • All implementing entities of World Bank projects will implement specific mitigation measures to address non-discrimination. • Under these projects, no one will be discriminated against or stigmatized, and the principles of nondiscrimination and inclusion will be adhered to. Support shall be provided to all project beneficiaries. • These mitigation measures will require enhancing project grievance redress mechanisms as well as strengthening existing project monitoring by implementing entities including third-party monitoring [the Enhanced Implementation Support Mechanism] where applicable. • Each project implementation entity shall develop comprehensive guidelines to address nondiscrimination."
National Regulatory Framework	
Environment and Social Impact Assessment Regulations, 2020	The Environmental Impact Assessment Regulations require a detailed study to determine possible environmental impacts and mitigation measures. The guidelines require that the ESIA process shall be participatory, engaging the general public and stakeholders in consultations or to inform them and obtain their views about the proposed development during the ESIA.
National Air Quality Standards, 2006	This regulation explicitly makes the contractor responsible for ensuring that the air quality is kept within acceptable limits during the project implementation.
National Environment (Noise Standards &	This regulation prescribes allowable night and day-time noise limits that shall not be exceeded in different land use locations. This regulation explicitly makes the contractor responsible for ensuring that noise levels are kept within acceptable limits during the project implementation.

Control) Regulations, 2003	
National Environment (Waste Management) Regulations, 2020	These regulations apply to: ▪ all categories of hazardous and non-hazardous waste; ▪ storage and disposal of hazardous waste and its movement into and out of Uganda. The regulations, which will relate to overall waste management (promote and minimise waste generation) during the construction phase, by: ▪ eliminating use of toxic raw materials; ▪ reducing toxic emissions and wastes; ▪ recovering and reuse of waste wherever possible. The regulations relate to overall waste management (promote reuse and recycling and minimise waste generation) during the construction phase.
National Environment (Conduct and Certification of Environmental Practitioners) Regulations, 2003	The client (MWE) in adherence to the requirements of the regulations engaged a registered environmental firm (Air Water Earth Ltd-CC/EP/010/22) bearing a competent team of registered environmental practitioner's under NEMA to undertake the project ESIA.
National Environment (Audit) Regulations, 2020	This regulation is relevant to the project as it keeps the operations of the project in-check with regards to the approval conditions stipulated in the approval permit issued. It also recommends an Audit to be carried out, at most three years after commencement.

Table ES 4: The World Bank Safeguard Policies triggered by the project include:

a)	OP 4.01 Environmental Assessment	Is triggered because the project will involve construction of irrigation infrastructure, storage reservoirs on River Kiruruma to enhance large scale irrigation of over 4420 ha hence, a need for conducting this Environmental and Social Impact Assessment. The scale of the works qualifies the project to be placed under Environmental Assessment (EA) Category A with significant environmental and/or social risk and potential impacts.
b)	OP 4.36 Forests	Is triggered in view of the project induced potential impacts to the Queen Elizabeth National Park (QENP) biosphere reserve downstream of the command area. Hence downstream ecosystem baseline has been recorded and mitigation measures included.
c)	OP 4.09 Pest Management	Is triggered because the project is aimed at boosting agricultural production and income at household level amidst climatic variability which is one of the factors leading to proliferation of crop and livestock pests and diseases whose control will likely require use of pesticides and agro-chemicals. As such, Integrated Pest Management Plan has been prepared as part of this ESIA.
d)	OP 4.10, Indigenous Peoples	Is triggered because of presence of Batwa identified in the zone of influence as Vulnerable and Marginalized Group (VMG). MWE has prepared a VMGs' Framework (VMGF) and is committed to prepare and implement a Vulnerable and Marginalized Groups' Plan (VMGP) targeting the Batwa. The Batwa have been consulted by the ESIA team and their views captured in the report. Since it is only the Batwa that have been mapped as Vulnerable and Marginalized within the project area, MWE shall prepare and implement one VMGP.
e)	OP 4.11 Physical Cultural Resources	There are no known PCRs to be impacted by the project. However, in the unlikely event that during excavations PCR are found this OP 4.11 shall be triggered. In this regard a chance finding procedure has been provided under section 4.9 of this document. to guide handling and management of chance finds.
f)	OP 4.12 Involuntary Resettlement	Is triggered because the works will necessitate land take triggering compensation and resettlement of project affected persons (PAPs). Accordingly, a Resettlement Action Plan (RAP) has been prepared alongside this ESIA report;
g)	OP 4.37 Safety of Dams	Is triggered by construction of a large dam whose design and management plans have been reviewed by an independent panel of experts. Dam Safety Management and Emergency Plans have been prepared for the Matanda dam scheme alongside the ESIA to provide guidance on dam management during operation and in the event of failure. The Government

		of Uganda (GoU) has a dam safety panel in place, established under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and Nile Cooperation for Results Project (NCORE) funded by the World Bank.
h)	OP 7.50 Projects on International Waters	Is triggered because the project is hosted by R. Kiruruma which drains into R. Kagera, which is a transboundary river. Riparian notification on the project was undertaken by GoU through the Nile Basin Initiative on November 13, 2018. Only Tanzania responded to give no objection, while the rest of the countries did not respond. The following Riparian States were notified: Burundi, DR-Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, and Tanzania.

Box 0-2: Applicable Ugandan plans, institutional framework and international conventions

National Plans

- The National Development Plan 2015-2020, 2021-2025;
- The Uganda Vision 2040;
- Agricultural Sector Strategy Plan 2015/16-2019/20;
- The National Irrigation Master Plan for Uganda (2010-2035);
- Parish Development Model; 2021-2026

Institutional Framework

- Ministry of Water and Environment (MWE)
- National Environmental Management Authority (NEMA)
- Directorate of Water Resources Management (DWRM)
- Ministry of Gender, Labour & Social Development (MGLSD)
- Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)
- Uganda Wildlife Authority (UWA)
- National Forestry Authority (NFA)
- Ministry of Lands Housing and Urban Development (MLHoUD)
- Ministry of Internal Affairs (MIA)
- Local Administration Structures

International Conventions and/or Agreements to which Uganda is Party

- The Convention on Biological Diversity (CBD), 1992
- UNESCO World Heritage Convention, 1972
- The Ramsar Convention on Wetlands, 1971
- The African Convention on the Conservation of Nature and Natural Resources, 1968
- The Convention for the Safeguarding of the Intangible Cultural Heritage, 2003
- The United Nations Framework Convention on Climate change (UNFCCC), 1992
- The Stockholm Convention on Persistent Organic Pollutants, 2001
- Convention on Protection and Use of Transboundary Watercourses and International Lakes, 1992
- Guidelines of the World Commission of Dams (WCD), 1998
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973
- Convention on the Conservation of Migratory Species of Wild Animals, 1979
- Strategic Approach to International Chemicals Management (SAICM), 2006
- Convention on Elimination of All Forms of Discrimination against Women, 1979
- Convention on Protection of Migrant Workers, 1990

- International Labour Organization (ILO) Convention No. 190: Violence and Harassment Convention, 2019: Uganda ratified this convention on August 7, 2023. It was the first international labor standard to address workplace violence and harassment.
- International Labour Organization (ILO) Convention No. 87 on Freedom of Association and Protection of the Right to Organise Convention, 1948: Uganda ratified this convention on June 2, 2005.
- International Labour Organization (ILO) Convention No. 100 on Equal Remuneration Convention, 1951: Uganda ratified this convention on June 2, 2005.
- International Labour Organization (ILO) on Minimum Age Convention, 1973 (No. 138): Uganda supports efforts to eradicate child labor.

Permits to be applied by the contractor

- Project NEMA approval certificate issued by NEMA
- Workplace Registration issued by MGLSD/OHS
- Waste Transportation License issued by NEMA
- River Dredging Permit issued by DWRM
- Surface Water Abstraction Permit DWRM
- Construction Works Permit issued by DWRM
- Petroleum Storage License issued by MEMD
- Storage of Explosives issued by MIA
- Hoarding Permit issued by local authorities

Agreements to be reached by the contractor

- Lease/Rental agreement for the Camp site Lease agreement for the Borrow sites and access roads
- Lease agreement for the Quarry site
- Memorandum of Understanding with a NEMA registered hazardous waste handler
- Memorandum of Understanding with domestic waste handler/ Municipal/ Kanungu District
- Memorandum of Understanding with area Health Centers

11. Assessment Methods

A number of methods were applied including literature reviews and field investigations for the identification of sensitive receptors, baseline data collection and analysis including biodiversity assessment, hydrology and water resources assessment, pests and diseases assessment, archaeology and cultural heritage assessment, noise assessment, air quality, and water quality assessment, as well as stakeholder consultations and direct observations. Both NEMA and World Bank Guidelines were followed while carrying out the assessments.

Table ES 5: Study methodological approach

Methodology	Brief Description
Review of existing literature related to the project	▪ Uganda Policy, Legal, Regulatory and Institutional Framework ▪ Review of international guidelines, safeguards and documents ▪ Final feasibility study report for the Project ▪ Draft Detailed Design Report for Project

Methodology	Brief Description	
	▪ Kanungu Local Government District Development Plan 2020/2021 – 2024/2025 ▪ Matanda Irrigation ESIA Inception report ▪ Matanda Irrigation ESIA Scoping report and ToRs	
Physical Baseline Data Collection	Air Quality Measurements	Baseline ambient air quality was measured using a non-passive sampling method using a Casella Microdust Pro™ digital aerosol monitor and a set of three MX6 iBrid™ portable gas monitors. Baseline meteorological conditions such as temperature, humidity, illumination, wind speed and direction were measured using CEM DT 8820 and Kestrel 4500NV pocket weather Tracker.
	Ambient Noise Measurements	Noise measurement done with a CASELLA CEL-621C2/K1 Integrating 1/3 Octave Band Sound Level Meter (Class2).
	Ground vibration	The baseline vibration measurements were taken using a calibrated Nomis SuperMini® Seismograph.
	Scheme hydrology	The main hydrological/hydraulic analysis was based on the Building Block Methodology (BBM). The BBM assumes that under the natural flow conditions in a river, different flows (high, medium, low) play different roles in the ecological functioning of a river. It is based on the premise that riverine communities and species are reliant on basic elements or building blocks of the flow regime. Hence, it is necessary to retain key elements of natural flow variation to ensure healthy river. The building blocks are different components of flow which, when combined, create a flow regime that facilitates the maintenance of the river in a required condition. Major components of a river ecosystem, both physical (hydrology, physical habitat, and chemical water quality) and biological (vegetation, fish and macro-invertebrates), were considered, as was subsistence use of the river by riparian people. For each of these disciplines, all available data was synthesized, and new data collected where necessary. Field measurements included the surveying of cross-sections at representative sites along the river, and development of the relationship between flow and water depth, velocity, and area of inundation. The biological specialists conducted field studies, from which they developed an understanding of the links between aquatic species and the flow in the river at different times. A flow regime was then developed depending on this understanding.
	Mapping	Global Positioning System (GPS) points were obtained from the project site layout, and field surveys by different specialist teams. A software known as Arcmap11 was used for analysis.
Biological survey	Biological surveys carried out on River Kiruruma and the command area aimed at identifying major components of ecosystem, including: a) Vegetation and flora habitat sensitivity was assessed on account of the presence of taxa. b) A standard bird population monitoring line transect counts method was adopted. c) Assessing mammal species presence, density and range estimations, based on modification of Pooled Local Expert Opinion method, transect counts, non-letal trapping (small mammals) and identification of mammalian dung, calls, tracks and footprints. d) For amphibians and reptiles three sampling methods, including Visual encounters surveys, Opportunistic observations, and Audio surveys, were used in the study. e) Fish surveys were done through experimental fish catches supplemented by artisanal fish catches from the locals. f) Insects (butterflies as surrogates) assessed through sweep-netting and oportunistic observations.	

Methodology	Brief Description
Socio-economic baseline survey	Socio-economic baseline conditions survey was important in understanding conditions, such as; Land use in site zone of influence, Existing infrastructure, Settlement patterns, Circulation patterns, Social cohesion, Population demographic, Community structure, Employment characteristics, Local economy and income distribution, Social services, Indigenous peoples, ethnic or tribal customs, Physical cultural resources, Public health, Gender-based violence and violence against children, Agricultural patterns, through data collection methods including; Observation, Focus group discussions, Interviews (Semi-structured interviews and In-depth interviews). A total of 2,144 randomly targeted households participated in a quantitative sampling procedure (questionnaires).
Stakeholder consultations	The objectives of stakeholders' consultations during the ESIA process were to share project information with a wide range of stakeholders, to obtain baseline information, and to allow stakeholders the opportunity to make comments and express their views on the proposed project. This was carried out through ● Individual interviews with key government stakeholders; ● Consultation with specific focus groups selected with reference to the project objectives at the local level (e.g., local communities officials and elders); and ● Community meetings.
Impact identification, assessment, mitigation	This involved a detailed environmental and social impact assessment and evaluation of the positive and negative, direct and indirect, short, immediate and long term, and permanent and temporary, and cumulative impacts due to the proposed project construction and future operation works. Impact significance was evaluated (very low, low, medium, high) based on impact intensity and receptor sensitivity.

12. Zone of Influence

Table ES 6

Environmental Change	ZoI Definition & Justification	Zone of Influence
E-Flow	ZoI is considered as that part of the river where the water abstraction for the purpose of irrigation scheme development could affect the ecological functioning of the river if mitigation measures were not appropriately implemented.	River downstream of the abstraction point to that point where substantial flows would be added to the river system. Specifically, river section between the proposed abstraction points and the point of confluence of R. Kiruruma, R. Rushaya and R. Mitano. QENP is located down streem of the confluence of Rivers Kiruruma, Rushaya and Mitano which are outside the zone of influence. The abstraction point for the Irrigation scheme is at the RCC dam to be constructed across Kiruruma River creating a storage of up to 22.7MCM inundating an area of 259ha comprised of farmland.

Land take, land cover change	Land-take/land cover change will only take place in areas where construction / decommissioning is planned.	Command area: The land uptake for the command area will comprise of secondary and tertiary pipe network, scheme structures (buildings and facilities, sanitation facilities), and scheme roads.
Ecological and aquatic	The geographical area and the ecological features within it which have the potential to be impacted by the Project.	Dam site + Command area + 1km offset from Command area
Fauna, flora, social, pollution	The geographical area within which views of the construction and operational phases of the Project could potentially be possible. Project's AoI as described in section 5.3.2.	Dam site + Command area + 1km offset from Command area
Cumulative impacts	The overarching spatial scope of the cumulative impacts is based on the Project's Area of Influence (AoI) as described in section 5.3.1 and 5.3.	Kanungu District
Social impacts	Administrative boundaries of the project area.	Dam site sub-counties Command area villages

13. Description of the biophysical baseline conditions in the project area

A. Environmental physical baseline

a) **Geographical Location**: Kanungu is one of the districts in the Southwestern region of Uganda, located between UTM 35M 795188mE 9935198mS of the Equator, bordering the Districts of Rukungiri in the North and East, Kabale in Southeast, Kisoro in the South, Lake Edward in the North and the Democratic Republic of Congo in the West.
b) **Topography:** Kanungu District lies in the fringes of the western Rift valley. The terrain in Matanda is relatively flat as you move towards the proposed Matanda Irrigation Scheme command area.
c) **Geology and Soils:** The most common types of soils are greyish brown sandy loams and reddish-brown sand (especially in Kihihi and Nyamirama sub counties).
d) **Climate:** The district has a tropical type of climate receiving moderate and well distributed annual rainfall (70 mm - 220 mm) between the months of March – May and September – December days respectively. The rest of the months are dry with average temperatures ranging from 15ºC to 22ºC.
e) **Ambient Air Quality:** Monitoring indicates a generally pristine environment with respect to air quality. At all locations, TSP levels conformed to the draft national limit of 0.3 mg/m^3 (PM10 and PM 2.5) and gas monitoring equipment did not detect CO, NO_2, SO_2 and combustible gases.
f) **Ambient Noise:** The command area is considered good and noise free with its primary non-point source of noise being the vehicles traveling through the village. Wind in the project area is generally moving in the Northwestern direction, hence pollutants or emissions from this kind of wind speed (0.3 m/s – 3.3 m/s) are not likely to go far or exceed 6 km ranges on average.
g) **Ground Vibrations:** Baseline ground vibration levels ranged between 0.1 and 1.1 mm/s.
h) **Water quality (dry season):** A comparison with WHO drinking water standards indicated that the water from the sampled locations did not comply for turbidity, TSS and Total Iron. This was mainly attributed to the chemical composition of the catchment ecology.

i) **Water quality (wet season):** A comparison with WHO drinking water standards indicated that the water from the sampled locations did not comply for turbidity, TSS, Fluorides and Total Iron. The measured apparent colour and turbidity levels, suspended solids and total iron concentrations for these sources negatively impacts the aesthetics of the water. The dependence of agriculture on chemical pesticides and herbicides (Butanchlor, Propanil and Atropine Sulphate) which are a vital input in today's agriculture, protecting food and fiber from damage by insects, weeds, diseases, nematodes, and rodents was evident in the project area

j) **Hydrology**: The district has many small rivers and streams like Ishasha, Nchwera, Kiruruma, Birara, Mitano and Lake Edward. E-flow requirement for R. Kiruruma would be 0.64 m^3/s with a flood of 13 m^3/s occurying once in two years.

Table ES 7: Physical Baseline Conditions

Maintenance Flows	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Flow [m^3/s]	0.11	0.13	0.13	0.16	0.16	0.13	0.11	0.13	0.17	0.19	0.18	0.14
	FDC %	100	100	100	100	100	100	100	100	100	100	100	100
Optimal fish condition flows	Flow [m^3/s]	1.53	1.76	1.70	2.08	2.17	1.68	1.52	1.71	2.35	2.50	2.43	1.87
	FDC %	28	23	27	29	26	28	30	31	26	30	30	32
Engineering design flows	Flow [m^3/s]	0.638	0.638	0.638	0.638	0.638	0.638	0.638	0.638	0.638	0.638	0.638	0.638
	FDC %	94	91	92	94	96	93	92	94	97	95	96	96

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flow [m^3/s]	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
FDC %	94	91	92	94	96	93	92	94	97	95	96	96

Small Flood peak [cumecs]	13
Small Flood duration [days]	5
Small Flood timing [Julian days]	289
Small Flood freq. [No per yr]	Once every two years
Small Flood rise rate [Δdisch/day]	5.7cumecs/day
Small Flood fall rate [Δdisch/day]	-4.7/cumecs/day

Water Quality

LOCATION	DO%	DO (mg/L)	pH	Temp (°C)	Atmospheric pressure (mbar)	EC (µS/cm)	TDS (ppm)	Salinity	ORP
R. Kiruruma (Kinyamashe)	34.83±2.74	2.56±0.06	6.62±0.15	20.67±0.06	901.83±0.12	43±16.99	21.33±8.26	0.02±0.01	-16.83±5.35
R. Kiruruma (Nyakarumbi)	35.17±2.95	2.63±0.19	6.09±0.08	21.25±0.18	906±0	42±11.43	21±5.72	0.02±0.01	-10.53±5.73
R. Kiruruma (Nyakashure)	21.03±0.66	1.62±0.06	6.24±0.13	22.74±0.23	910.8±0.41	50.33±11.09	24.33±4.03	0.02±0	-1.33±1.58
R. Kiruruma-Reservoir Area	19.6±0.37	1.49±0.07	6.71±0.12	21.91±0.14	900.67±0.21	41±1.41	20.33±0.94	0.02±0	-4.63±0.87
Spring	13.17±0.25	0.96±0.01	6.76±0.07	25.8±0.22	910.57±0.49	77.33±4.78	39±2.16	0.03±0	-15.1±1.81

Sample ID/Parameter	**PA** - R. Kiruruma (Kinyamashe)	**PB** - R. Kiruruma (Nyakarumbi)	**PC** - R. Kiruruma (Nyakashure)	**PD** - R. Kiruruma-Reservoir Area	**PE** – Spring	WHO drinking water standards*
Apparent colour (PtCo)	471	590	630	570	340	Ns

Turbidity (FAU)	69	80	82	85	49	5
Total suspended solids (TSS) (mg/l)	62	75	89	77	57	Nil
Total Alkalinity (mg/l)	135	140	145	150	105	Ns
Nitrates (mg/l)	nd	Nd	nd	nd	6.3	50
Ammonia nitrogen (mg/l)	0.013	0.011	0.005	0.010	0.015	Ns
Total Phosphorus (mg/l)	0.592	0.674	0.68	0.842	0.484	Ns
Fluorides (mg/l)	0.20	0.20	0.30	nd	0.50	1.5
Total Iron (mg/l)	2.91	3.02	3.08	3.62	0.78	0.3†
BOD5 (mg/l)	28	31	26	42	19	Ns
COD (mg/l)	78	92	52	97	50	Ns

B. Environmental Biodiversity Baseline

k) Flora: The vegetation ranges from the high tropical forests of Bwindi impenetrable National Park to the grasslands of Queen Elizabeth Biosphere Reserve. The vegetation of the project area is mainly influenced by agriculture and settlement. The vegetation cover is composed of crop gardens, tree woodlots, patches of riverine bushed woodland; strips of mixed woody vegetation along the river, patches of bushed woodland (colonizing forest) on uncultivated private land and grassland fallow amidst cultivated sites. The site yielded 233 plant species in 170 genera and 57 families. Ninety percent of the scheme vegetation cover consists of crops of which maize, coffee, banana, cassava and millet cover about 80%. The natural vegetation cover constitutes less than 10% of the total vegetation cover in the project area. Species recorded were largely of Least Concern (LC) according to International Union for Conservation of Nature (IUCN). However, Mvule (*Milicia excelsa*), globally Near Threatened (NT) and nationally Endangered (EN) and the brown mahogany (*Lovoa swynnertonii*) Bak.f, globally Vulnerable (VU) were also recorded.

l) Fauna:

Mammals: Two small-sized mammalian species; the common house rat (*Rattus rattus*) and the African pygmy mouse (*Mus minutoides*) both of order Rodentia were recorded with very low species richness which can be attributed to intensive agriculture. Kishunju cell had the highest diversity index at 2.32. The only artiodactyl recorded within the downstream community sites in this study was the bushbuck, a LC species. However, sites adjacent to Queen Elizabeth recorded several artiodactyls but all under the LC status. For small mammals, Ethiopian epauletted fruit bat (*E. labiatus*) of the order Pteroporididae, a LC species, was the only bat species observed. Several species recorded during this survey, including Spotted necked otter (globally - Near threatened), African elephant (Endangered), Hippopotamus (Vulnerable), African Lion (Vulnerable) are listed by both IUCN (global) and the National Red List (WCS 2016). However, they are widely distributed where they are known, while the Spotted necked otter is known to occur in deeper flowing waters of the surrounding rivers and beyond although it is rarely sighted.

Birds: A total of 104 bird species with a wide range of habitat preference were recorded. There was no record of species in the category of Critically Endangered (CR), however, there was one Endangered species (EN) at both global and national categorisation, but regionally Near Threatened, the Grey Crowned Crane (*Balearica regulorum*). The species is known to be widely distributed in the project area and across Uganda but with dwindling numbers mainly due to wetland habitat loss

occasioned by the ever-expanding agriculture and infrastructure. The other species of conservation concern (Regional Responsibility), classed R-RR species, are Cinnamon-chested Bee-Eater (*Merops oreobates*) and Grey-capped Warbler (*Eminia lepida*). Water withdrawal will not impact these species since they are widely distributed in the project area and across Uganda.

Amphibians: Overall, 146 amphibians were recorded in the project area with 37 more records encountered in Rwengoboko. The most common amphibians (encountered most) were Mascarene grass frog (*Ptychadena mascareniensis*) and common reed frog (*Hyperolius variabilis*), abundant in the project areas. The amphibian species recorded during the survey are considered Least Concern by the IUCN red list of 2018 and National red list (WCS 2016) due to their wide distribution.

Reptiles: A total of 48 reptiles have been recorded mainly around Kameme. Herptilian species diversity was highest in Rwengoboka followed closely by Kashojwa and Kameme. Among the species recorded, those that have been evaluated are of Least Concern (LC) due to their wider distribution and are not known to be undergoing any population decline or threat in habitat quality IUCN (2018).

Fish: River Kiruruma is endowed with a variety of fish species that thrive throughout the different river sections, especially during the wet and high-water level seasons. A total of 14 fish species from 9 genera and 6 families were recovered around the proposed areas of development with the carp family Cyprinidae being the most abundant and diverse taxa. The majority (>50%) of the fish species caught at Kiruruma upstream were haplochromine cichlids. The majority of the fish species recovered are of Least Concern (LC) according to the IUCN Red List data, in relatively good condition and comprising majorly juveniles and few adults' populations feeding on macroinvertebrates. On the other hand, according to the IUCN Red Data Lists, yellowfish (*Labeobarbus* sp., formerly genus *Varicorhinus*) within the Mount Rwenzori foothills is ranked as Vulnerable (VU) due to its restricted habitat range. This genus was recovered in the river Kiruruma.

Butterflies: A total of 79 butterfly species in five families (Appendix E) were recorded. No IUCN threatened or endangered species would be impacted by the proposed activities because none of them was observed or is known to be present in the areas covered by this project.

C. **Socio-economic Baseline**

m) Education: The highest level of education attained by most of the household heads is primary education (71.6%), followed by ordinary level (19.1%) and vocational training (3.6%). 2.4% of the household heads have completed advanced level whereas 3.1% have completed university.

n) Land Use: The main land use in the project area is agriculture and mainly crop farming; however, other use depends on ownership, tenure, and customs. Cultivation covers most hilltops and many wetlands have been drained, while very little of the original forest outside the parks remains. Land shortage, coupled with intensive use for subsistence agriculture, has led to soil degradation, poor yields and ultimately poverty. The land is highly fragmented due to traditional practices of inheritance and high population density.

o) Livelihood Strategies: Findings from the household survey indicated that agriculture is the dominant source of livelihood for the households in the command area. Most households (94.1%) are involved in crop farming. Other sources include trade (1.5%), salary/wage (1.9), transportation (0.6) and others. Farming in the command area is mainly subsistence and most of the farmers practice mixed farming. The major food crops grown include maize, beans, and millet whereas crops

such as Rice and Irish potatoes are grown on a small scale. Cash crops are also grown in the command area; coffee being the predominant crop. A few households grow cotton and tobacco.

p) Health: Every Subcounty in the command area has got at least one health facility at level II. The HC IIs provide the first level of interaction between the formal health sector and the communities. Findings of the household survey indicated that most of the households (78.4%) had malaria as the common disease. Results also indicated that the majority (90.4%) of the households stated that at least one member of their family had fallen sick in the last 6 months. The conditions/diseases suffered included flu/cough, skin diseases, intestinal worms, diarrhea diseases, asthma, diabetes, pressure, and typhoid among others.

q) Access to water: The sources of water for domestic use in the project area include communal boreholes, rivers, rainwater, taps and protected springs. Findings of the socioeconomic survey showed that the majority (42.6%) of the household heads fetch water from yard taps/public tap stands, 24.7% mentioned they fetch water from rivers and streams in the project area whereas 19.2% from protected springs and 5.0% harvest rainwater.

r) **Communication:** Information in the project area is best received through radio followed by community meetings. The most listened to radio in the project area are Radio Kinkiizi, Kanungu Broadcasting Services, and Kanungu FM Voice of Kigezi. Other stations listened to include Voice of Rukungiri, Radio West, Grace Radio, and Radio Uganda among others.

s) **Archaeological and cultural heritage**: Focal point discussions in all the six sub counties of Kanungu district described the Banyabutumbi community tree in Kihihi town council, as the outstanding cultural heritage resource looked after by the Banyautumbi community association. There were no household shrines in the area observed. Nevertheless, household graves were identified sparsely across the project area, but they will not be affected by the project infrastructure. Pot shards of both modern and late iron age period were obsevered. Ekitazimuruka within Matanda village, where the traditional Bakiga tribe's art of metal implement production (blacksmiths) is still being practiced.

t) **Religion**: The population has adopted modern religions of Christianity and Islam.

14. Stakeholder consultations

Stakeholder consultations were carried out between 2018-19 to cover the original command area of 4420ha and in 2023, following a recommendation from the Bank to study the entire command area of 9000ha thus triggering more detailed consulations given potential changes in baseline conditions of the project area. The table ES8 below highlights key concerns during stakeholder consultations.

Table ES 8: Key concerns raised during stakeholder consultations

Stakeholder	Key concern	Responsibility	Recommendations
Kanungu District (01.011.2018), (07.02.2019) & (10.08.2023)	Land acquisition	MWE/Contractor	Agricultural land, property and crops affected due to construction of project infrastructure especially the distribution channels or pipes shall be fairly and promptly compensated for.
	Employment expectations & local content	Contractor	The contractor shall give first priority to the able persons from the local communities when recruiting especially for casual labour. This will promote project ownership in the community and overall improved cooperation between the contractor and the community.
	Waste management	Contractor	The contractor shall have a waste management plan and ensure proper collection, storage, transportation, and disposal of waste in a sanitary manner.
	HIV/AIDS	MWE/Contractor	Workers and communities shall be sensitized on HIV/AIDS. Free testing and counseling campaigns shall be held for workers and the communities.
	Impact on Physical Cultural Resources	MWE/Contractor	Cultural features e.g., the Banyabutumbi tree and graves shall not be destroyed during construction of the scheme. Where inevitable, the owners and local leaders shall be consulted on the procedure and requirements for relocation.
	Wildlife-human interaction	MWE/UWA	There is also need to consultant on the wildlife authority to ascertain the relationship between the project and wildlife.
	Project delays	MWE	The project needs to be fast-tracked. It has taken so long, and communities are getting fatigued over the project.
	Water source protection	MWE/Contractor	Water sources shall be protected throughout the project implementation.
	Community involvement	MWE/Contractot	Communities need to be reoriented about the project. It is equally important that the consultant also visit the sub counties and notify them about the updated studies.
Sub County/Town council stakeholders Nyamirama (07.02.2019 & 08.08.2019) Kihihi (07.02.2019) & (09.08.2023)	Employment	Contractor	During recruitment of workers, first priority shall be given to the local communities within the command area to promote project ownership and ensure its sustainability.
	Compensation for affected property	MWE	Property affected due to construction of the scheme shall be compensated for in a transparent and timely manner.
	Labour force management	Contractor	The contractor shall have a plan to manage his workers and shall put in place strict rules against crime. He/she shall ensure that all workers are given identity cards and are also registered and known to the Local Council 1 LC1 leaders of the respective areas of their operation.
	Increase in Promiscuity, Destruction of	MWE/Contractor	The contractor shall have a very strict employment code of conduct which prohibits sexual relationships with married women and underage girls and shall also conduct massive sensitization of both the workers

Stakeholder	Key concern	Responsibility	Recommendations
Kihihi Town Council (10.08.2019) Nyakinoni (08.08.2019) Nyanga (09.08.2019) Kanyantorogo (09.08.2019)	families and Marriages		and members of public within the affected communities to create awareness of the dangers involved in engaging themselves in extramarital relationships. Need to safeguard against domestic violence in the project area during implementation.
	Conservation	MWE/Contractor	Need for full-fledged biodiversity person to study biodiversity issues in the project area.
	Employment		Employment of the community members shall be emphasized during project implementation.
	Training and capacity building	MWE/Contractor	Training in irrigation-based farming practices needs to be passed on the farmers in order to benefit from the project.
	Project delays	MWE	There is a general community fatigue about the project. Endless meetings occurred with less implementation on the ground.
Community (15.11.2019-23.11.2019) & (9.-11.8.2023)	Employment	Contractor	Priority, especially of unskilled and semi-skilled labour shall be given to local communities in the command area.
	Land acquisition and compensation issues	MWE/Contractor	All affected property will be compensated for. The valuation and compensation exercise shall be transparent and shall involve local leaders and representatives of affected persons.
	Impact on water sources	MWE/Contractor	Water sources especially bore holes that may be affected as a result of project works shall be reconstructed or the project shall provide alternative sources of water for the community.
	Cultural site	MWE/Contractor	The project shall ensure that cultural sites and features are preserved during construction. In cases where they cannot be avoided, the developer shall consult the communities and caretakers of such sites to ensure right procedures are followed in relocating them.
	Social ills such as family breakage, defilement, rape, theft among others	Contractor	If possible, foreign workers shall come with their wives to avoid engaging in sexual relations with married women/men and school going children. Additionally, the contractor shall have strict rules that prohibit such interactions. The community raised concerns regarding influx of workers from other parts of the country which may cause tension in the communities since they usually do not move with their families. This may push them into engaging in sexual relations with married people hence breaking their marriages or escalating domestic violence, sexual abuse of school children hence increasing the number of school dropouts and early and unwanted pregnancies.
	Project delays	MWE	Need to FastTrack the project. The project has taken a period of over 5 years with less success.
	Project extents	MWE	Requested that the irrigation schemes be on a large scale to benefit the communities financially.
	Land issues	MWE	A common concern raised in all meetings was regarding property e.g., land, buildings, crops etc. that will be affected during construction of the irrigation scheme infrastructure; whether the loss will be compensated for and whether compensation will be adequate, fair and property owners paid before construction commences.
Batwa Community (23.11.2019)	Benefit sharing from Governenment programs	MWE	• They requested to be considered as beneficiaries of the different government programs such as the irrigation project, Operation Wealth Creation and NAADS among others. MWE will prioritise programs to support the Batwa community and also encourage the contractor to offer employment opportunities to the eligible Batwa.

Stakeholder	Key concern	Responsibility	Recommendations
	Training in Vocational skills		• The women are talented in handcraft and so requested for training to acquire skills in weaving such baskets, mats among others so as to make better products that can be sold to a wider market to supplement their income. These will be considered by MWE in the proposed vulnerable support program
UWA (06.03.2023)	Biodiversity Team	MWE/UWA	The consultant's team shall be composed of a full-fledged biodiversity team.
	Anthropogenic activities	MWE	All anthropogenic activities along River Kiruruma in the project area shall be captured and documented.
	Wildlife-human interaction	MWE/UWA	There is an existing trench at the Kigezi Wildlife side currently deterring elephant crop raiding. The trench has been in existence for decades and is continuously maintained by the community with support from UCF and WCS. In addition, the electric fence is currently being constructed under the Investing in Forests and Protected Areas for Climate-smart Development Project (IFPA-CD, financed by the World Bank, P170466) to cover the Ishasha sector to the Kigezi side thereby providing a solution to the Human-Wildlife problem that was earlier anticipated.

15. Main Environmental and Social Impacts of the Project

Matanda Irrigation Scheme Project consultations revealed that one of the biggest challenges to farmers is drought and most times, they lose their crops. Irrigation in this area will therefore have huge potential positive impacts for the communities. The positive impacts identified outweigh the negative impacts as shown below. The negative impacts can be managed and mitigated using the measures shown below. The overall conclusion is that the economic benefits of constructing Matanda irrigation scheme are significant and will help reduce poverty and hunger in the communities, including providing climate resilience coping mechanisms to the populace in the project area. Potential environmental and social impacts of the proposed project and mitigation recommendations are summarized in the tables below:

Table ES 9: Summary of predicted positive impacts and recommended enhancement measures

Predicted Positive Impact	Phase	Recommended Enhancement Measures
Transformation and training on climate smart agriculture practices in the area	Operational phases	● Training on integrated management of insecticides and pesticides. ● Credit societies and farmers associations shall be strengthened to provide loans to the cultivators. ● Adoption of farm management software. ● Increased coordination and planning by Kanungu District agricultural officers and Engineers, MAAIF, MWE concerning agricultural activities in the scheme. ● Adoption of land reform that clearly defines property rights, ensures the security of land tenure, and enables land to be used as collateral will be necessary.

Predicted Positive Impact	Phase	Recommended Enhancement Measures
Sustainable and optimal use of irrigation water resources	Operational phases	● Ensuring proper water drainage and water management. ● Community sensitization regarding irrigation technology utilization. ● Integration of other government programs related to irrigated agriculture to support the scheme. ● Training on agricultural production, value addition and market linkages.
Benefit to local retail businesses	Pre-construction, construction, and operational phases	● During the project progress meetings with the local community, the residents shall be informed about the project and how their businesses can benefit from the project. ● Sensitization of the construction contractor and his staff about public health aspects mainly based on consumption of such foodstuffs bought at the construction site from the locals. ● Use of quality products with standards meeting those of the Uganda National Bureau of Standards.
Provide employment opportunities	Pre-construction, construction, and operational phases	● Adoption of a Labour Management Plan. ● All contractors' staff shall bear appointment/offer letters, contracts, and an identification tag. ● The contractor shall use locally available labour as much as feasible. ● Persons seeking employment will have to be screened, including references from the local Council Chairpersons of their villages of origin before engagement. ● To the extent possible, equal employment opportunities shall be available for women. ● The construction contractor will be obligated to work within Uganda's labour laws (Employment Act). ● Adequate occupational health and safety (OHS) standards shall be provided to ensure the work environment is conducive.
Improved land conditions and household acreages	Operational phases	● Safe and sustainable utilization of fertilizers. ● Credit societies and farmers associations shall be strengthened to provide loans to the cultivators. ● Scouting the farmland. ● Regular testing of farmland soil quality. ● Weeding early and often. ● Applying conservation tillage practices to save time, fuel, and machinery wear. ● Sensitization of farmers in the command area about the right type of fertilizers available, prices and applications.
Crop diversification and intensification	Operational phases	● Sensitization of farmers regarding the adoption of pest resilient crops and technology arrangements. ● Practice of seasonal soil rotation. ● Use of high-quality and low-cost seed. ● Carrying out sound research and development initiatives on resilient crop types. ● Cropping technical assistance and knowledge sharing. ● The selection of a low volatile or highly productive cropping system.

Predicted Positive Impact	Phase	Recommended Enhancement Measures
Expansion of land under irrigated agriculture	Operational phases	● Adoption of land reform that clearly defines property rights, ensures the security of land tenure, and enables land to be used as collateral will be necessary. ● Ensuring proper water drainage and water management. ● Community sensitization regarding irrigation technology utilization. ● Integration of other government programs related to irrigated agriculture to support the scheme.
Improved food security and nutritional status	Operational phases	● Provision of intermediate technological solutions. ● Adoption of policies supporting private and public agricultural input and output, market development, and inducing adoption of more diverse, resilient, and profitable cropping systems. ● Adoption of crop diversification as a strategy for addressing food and nutritional security.
Market Infrastructure	Operational phases	● Widening of marketing infrastructure. ● Adoption of price support policy. ● Supply of quality inputs at proper times and at controlled prices.
Enhanced values of the agricultural produce	Operational phases	● Planting early and effectively. ● More emphasis shall be made to set up cottages and small-scale agro-produce industries.
Tourism potential	Operational phases	● Construction of the scheme as per standards and specifications in the approved design. ● Implementing a scheme maintenance plan.
Dam filling	Operational phases	● Monitor the colonization and changes in assemblage of aquatic and terrestrial life forms as the dam fills so as to possibly weed out unwanted invasive life forms such as water hyacinth. This shall include regular evaluation of the changing ecological effects. ● Facilitate movement and colonization of the filling reservoir with naturally suitable life forms, such as sedentary deep water loving life forms. ● Implement a monitoring plan to study the changes in hydraulic and hydrological parameters of the stream, and how the changes are impacting on productivity of the waters. ● Implement a reservoir management plan and adherence to and regular e-flow (Table 5-70). ● Allow for “facilitated” natural migration and colonization by all fishes in the catchment.

Table ES 10: Summary of predicted negative impacts and recommended mitigation measures

Predicted Negative Impact	Receptors	Phase	Recommended mitigation measures
Impact on public safety	Curious students and locals	Pre- construction, construction, operational and decomissioning phases	● Restrictions of unnecessary entry into the construction site. ● Hoarding off the source construction site. ● Conduct safety awareness campaigns in project communities. ● Enforcing safe vehicle speed limits. ● Usage of OHS signage that is clear and visibly displayed. ● Adoption of a Traffic Management Plan. ● Adoption of an Environment, Social, Health and Safety Plan. ● Adoption of a Grievance Management Plan.
Impact on local area water quality and hydrology	Water sources in the project area and biodiversity	Pre- construction and construction	● Keeping all construction equipment in good operating condition. ● Monitoring of water quality of the source. ● Proper hazardous wastes handling and management. ● Fuel handling and oil spill measures shall be implemented to prevent, control and address spills or leaks. ● Constant community and farmers sensitization on water pollution specifically use of pesticides. ● Use of fertilizers and pesticides meeting required standards. ● Adoption of a Spill Management Plan. ● Acquisition of water abstraction permits. ● Capacity building on efficient water use using Information, Education and Communication (IEC) tools. ● Establish early warning systems (EWS) on climate and water stress disasters.
Air Pollution	Project community, contractor, project biodiversity	Pre- construction, construction, operational and decomissioning phases	● Use of low emission equipment as much as practicable. ● Undertaking regular maintenance of equipment and vehicles. ● As far as possible, source material from locations close to the sites. ● No open burning of waste practice shall be adopted. ● Use of sustainable fertilizers and pesticides. ● Proper application of sustainable fertilizers and pesticides. ● Covering of trucks delivering materials with tarpaulin. ● Limit vegetation clearing to the minimum. ● Optimize the logistics to maximize use of available vehicles. ● Adoption of a Dust Management Plan. ● Continuous monitoring of air quality against regulated emission levels, such as NEMA's draft air quality standards.

Predicted Negative Impact	Receptors	Phase	Recommended mitigation measures
Noise Pollution		Pre- construction, construction and decomissioning phases	● Construction activities shall be limited to daytime in proximity of residential areas. ● Project machines shall be turned off when not in use. ● Provision of appropriate personal protective equipment (PPE). ● Adhere to the regulatory noise limits for a construction site. ● Adoption of a Noise Management Plan. ● Continuous communication on project activities to ensure community awareness.
Degradation of soils and soil erosion	Project area; soils, drainage, and flora, command area soils and downstream biodiversity	Pre- construction, construction, operational and decomissioning phases	● Limiting of clearance of vegetation. ● Proper storage of excavated soils. ● Control of oil leakages. ● Trench back-filling material shall be compacted to a level similar to the original surrounding soils. ● A spill kit shall be maintained onsite. ● Use of retention ditches. ● Adoption of a Waste Management Plan. ● Constant community and farmers sensitization on soil contamination specifically on use of pesticides. ● Continuous monitoring of soil quality against regulated emissions. ● Continuous monitoring on application of fertilizers and pesticides. ● Adoption of a contractors Soil Erosion Control Management Plan.
Social misdemeanor by workers	Project community	Pre-construction, construction, and operational phases	● Sensitization about responsible sexual behavior. ● Workers are prohibited from interaction with the school students. ● The contractor shall follow up any grievances from the community and the schools. ● Conduct background checks on all people before employment. ● Hire security guards from a registered company. ● Collaborate with the local administration including LC1s, police post and Kanungu District police station. ● Placement of “No Trespassing” signage. ● Deployment of contractor’s code of conduct. ● Adhere to community and Kanungu District bylaws, national legal framework on social and health conduct. ● Deployment of a contractors Labour Management Plan.

Predicted Negative Impact	Receptors	Phase	Recommended mitigation measures
Management of generated waste	Contractor and Project; community, biodiversity, water sources, atmosphere	Pre-construction, construction, and operational and decommissioning phases	● The contractor is obligated to ensure responsible waste management. ● Waste shall be collected, sorted, and temporally stockpiled in a designated area before haulage off site. ● Adoption of waste minimization. ● Adoption of principles of an integrated solid waste management system i.e., reduction at source, reuse and recycle. ● Waste transportation vehicles shall be covered. ● Handling waste in a manner consistent with national regulations. ● Usage of PPE during waste handling. ● Adoption of a Waste Management Plan. ● Constant community and contractor's sensitization on waste management. ● Continuous monitoring and annual Environmental and Social Audits of contractor's waste management practices.
Occupational Health and Safety	Contractor's worker force and command area cultivators	Pre-construction, construction, operational and decomissioning phases	● Wearing project identification tags. ● Induction of all new workers. ● Conducting daily toolbox meetings. ● Conducting periodic and on an as needed basis safety training. ● Use and placement of OHS signage. ● Hoarding off the source construction site. ● Providing fully equipped First Aid units. ● Personnel shall only undertake tasks for which they are trained/qualified. ● Use of formal 'permit to work' system. ● Supervision of works shall be done regularly. ● Adoption of a clear communication strategy. ● Provision of appropriate PPE. ● Hiring a qualified Health and Safety Officer. ● Acquiring a workplace registration license. ● Implementation of a Health and Safety Policy and Standard Operating Procedures. ● Adoption of an Occupational Health and Safety Management Plan. ● Adoption of an Emergency Response and Incident Management Plan.
Impact on Gender	Women and girls	Pre-construction, construction, and	● Equal employment opportunities shall be available for women.

Predicted Negative Impact	Receptors	Phase	Recommended mitigation measures
		operational phases	● Use of gender-sensitive language such as: “Go Slow, Work in Progress” instead of “Go Slow, Men at Work”. ● Sensitization about gender discrimination and all types of gender-based violence and sexual harassment. ● Paying an equal ‘living wage’ to all workers. ● Both men and women shall equally involve themselves in scheme agricultural practices. ● Women shall be allowed in the decision-making process of both the strategic and daily activities of the scheme. ● Respect women’s rights. ● Adoption of Code of Conduct for Contractors. ● Continuous sensitization about gender inclusion and women empowerment. ● Deployment of contractor’s code of conduct. ● Adhere to community and Kanungu District bylaws and national legal framework. ● Adoption of a Gender Mainstreaming Plan.
Land take	Community owned land	Pre-construction	● Conducting a Resettlement Action Plan (RAP) for the irrigation scheme. ● Adhering to both national legal framework and the World Bank Operational Policy (OP) 4.12 on Involuntary Resettlement. ● Continuous sensitization of the community. ● Continuous engagement with all project stakeholders. ● Deployment of project Grievance Management Plan as to capture and handle any land related grievances in relation to the project. ● Ensure compliance to recommendations of the RAP report and implement livelihood restoration actions as proposed.
Impact on project area ecology	Project area biodiversity	Pre-construction, construction, operational and decomissioning phases	● Adoption of environmental flow of 0.64 m^3/s for low flow regimes of R. Kiruruma and a one in two-year flood of 13m^3/s. ● Use of an eco-friendly design for the irrigation scheme. ● Restriction of equipment to the project footprint. ● Adhering to both national legal framework and the World Bank OPs on safeguard requirements, specifically OP 4.04 on Natural Habitats. ● Deployment of a decommissioning plan and restoration plans for all sites to alleviate biodiversity loss.

Predicted Negative Impact	Receptors	Phase	Recommended mitigation measures
Destruction of physical cultural resources (PCR) and archaeological heritage	Banyabitumbi community tree, graves, post shards, Batwa	Pre-construction, Construction and decomissioning phases	● Conducting a Resettlement Action Plan (RAP) for the irrigation scheme. ● A preconstruction survey of the RoW shall be undertaken. ● Preparation and adoption of Cultural Heritage Management Plan (CHMP) in anticipation of any chance finds. In addition, there are some cultural resources within the project area e.g the Banyabitumbi community tree, located in Kihihi Town Council, Rwanga ward and is looked after by the Banyabutumbi community association (Section 5.6.16 on Sites of Cultural or Religious significance) ● Implementation of the chance find procedure (CFP) included in Appendix A on Contractor Environmental and Social Management Plan in Volume II of the present ESIA in the event of excavation of PCR. ● Sensitization of workers about the CFP and relevant guidelines under OP 4.10 on Indigenous Peoples. ● Implementation of the relevant measures presented in the Vulnerable and Marginalized Groups Framework (VMGF) for Matanda irrigation schemes (Appendix F). ● Development and implementation of VMGP for Matanda irrigation schemes (outlined in Appendix F).
Land access / ownership challenges	Vulnerable categories, i.e. women, children	Operational phase	● Adoption of land reforms that clearly define property rights ensuring the security of land tenure, i.e. issuance of certificates of customary ownership of land, which enables land to be used as collateral.

Cummulative Impacts:

Projects considered under cumulative impact assessment in the project area include:

- Construction of Rukungiri-Kihihi-Ishasha-Kanungu road of 79km is substantially completed and at defects liability period (DLP) stage.
- Construction of an electric fence of 61km under Investing in Forest and Protected Area for Climate-smart Development (IFPA-CD)- P170466. project is over 80 % complete.

The **VESCs for Rukungiri-Kihihi-Ishasha- Kanungu and the electric fence projects include;**

- Wildlife
- Water

- Soil
- Terrain
- Land use
- Vegetation
- Birds

Table ES 11: Summary of predicted cumulative impacts and recommended mitigation and enhancement measures

Predicted cumulative Impact		Recommended enhancement/mitigation measures
Positive Impacts	➢ Reduced human-wildlife conflicts by the electric fence under construction by UWA.	The UWA shall continue maintaining and monitoring the integrity of the electric fence. Sensitization of the communities about the importance of the electric fence shallshall
	Improved access to social services from the Rukungiri-Kihihi-Ishasha-Kanungu Road	Kanunugu District Local government shall establish mechanisms for rallying communities to protect the project infrastructure.
	Roads shall spur development in the area	KannunguDLG and relevant government agencies shall promote physical planning, sensitization of communities to embrace development programs like the Parish Development Model (PDM) and ICRP shall promote agricultural productivity in the project area.
Negative Impacts	Increased air pollution from increased traffic along the Rukungiri-Kanungu road	The Ministry of Works and Transport together with the Uganda Revenue Authority shall regulate the importation of high emission vehicles Kanungu DLG and NEMA shall monitor air pollution and promote air quality management
	Increased noise pollution from increased traffic for communities along the Rukungiri-Kanungu road	UNRA shall install speed controls such as humps and speed limits along the human settlements Kanungu DLG and NEMA shall monitor noise pollution and promote air quality management Uganda Police Traffic Department to regulate non-compliant road users.

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16. Environmental and Social Management and Monitoring Plan

The goal of this Environmental and Social Management and Monitoring Plan (ESMMP) is to ensure that environmental and socio-economic issues continue to be fully integrated into the decisions of the irrigation scheme throughout its lifetime. It has been presented in such a format that provides a framework for managing and monitoring impacts for the life of the scheme, including:

A. **Managing**: E&S Anticipated Positive/Negative Impact; Proposed Enhancement/Mitigation Measures; Desired Outcome; Performance Indicators (Means of Verification); Responsibility; Implementation Time; Duration; and Cost Description (all costs in UGX).
B. **Monitoring**: E&S Anticipated Positive/Negative Impact; Monitoring Method; Performance Indicators (Means of Verification); Monitoring Frequency/ Responsibility; Implementation Time; Duration; and Cost Description (all costs in UGX).

Monitoring will be undertaken throughout the scheme's construction period and operational period. Table ES 10 provides an overview of the key logical reports necessary to ensure effective implementation of this project ESMMP, avoidance of doublicated efforts and ensuring that information is shared among all key parties.

Table ES 12: Environmental and Social Monitoring Plan

Activity	Monitoring frequency	Responsible entity	Output	Reviewer
Site operation	Daily	Contractor	Daily report	Contractor/SE/MWE-PIU
	Weekly	Contractor	Community outreach report	Contractor/SE/MWE-PIU /FTF
			ESHS and technical report	Contractor/SE/MWE-PIU
	Monthly	Contractor	Community outreach report ESHS and technical report	SE/MWE-PIU /FTF/KDMISTSC
Supervision and management	Daily	Supervising Engineer (SE)	Daily report	MWE-PIU
	Weekly	Supervising Engineer	Weekly supervision report	MWE-PIU
	Monthly	Supervising Engineer	Monthly supervision report	MWE-PIU /
		FTF	Monthly supervision report	KDMISTSC
		KDMISTSC	Monthly supervision report	Kanungu District Technical Planning Committee
	*Quarterly / Annually	All stakeholders	Minutes and inspection records Quarterly and Annual monitoring reports	Government of Uganda and the World Bank

*Quarterly progress review meetings focus on engineering progress, safeguards compliance and stakeholder feedback from the community and local government representatives.

17. ESMMP Supporting Plans

A. Integrated Pest Management Plan

The Integrated Pest Management Plan (IPMP) for Matanda irrigation scheme is part and parcel of improved good agricultural practices (GAPs) designed to support this setting up of irrigation facilities and ensure sustainable management of pests and diseases to complement the water management through irrigation.

The study involved a baseline study using both quantitative and qualitative methods of inquiry carried out among key district officials, focus groups, and individuals with the aim of identifying the key issues facing farmers ranging from drought, pests and diseases, and weeds and devising pest management options especially for crop pests and diseases. Direct observation and photography were used to capture the prevailing pest and disease concerns in the Irrigation catchment area, while the secondary review of literature to find out regulatory and policy issues around pest management, roles of key players, and how these are integrated to support the PMP in the irrigation scheme.

Pests and diseases along with drought are the main production challenges recorded in all the sub counties covered by the Matanda Irrigation System justifying the implementation of an irrigation system as well as design of an Integrated Pest Management Plan to support farmers in the Matanda irrigation area. Develop guidelines for development of appropriate methods to promote an Integrated Pest Management (IPM) approach that will minimize the need for chemical pesticides during project interventions.

The main crops affected by pests in Kihihi sub county are beans, coffee and maize with the main pests being caterpillars, stem borers and fall armyworm, beetles and weevils, and leaf miners. In Nyakinoni, coffee and beans are affected by a range of pests including mainly aphids, beetles/weevils, and coffee twig borer, with other pests including leaf miners, scales, white flies, and grasshoppers. In Nyamirama, pests attack crops including coffee, groundnuts, maize, beans, tomatoes, cassava, rice, and cabbage, and these pests include leaf miners, caterpillars, army worms and stem borers, aphids, beetles, weevils, whiteflies, scales, grasshoppers, and coffee twig borer.

Our engagements with the farmers during data collection revealed that farmers were not adequately aware of Integrated pest management (IPM) concepts, despite practicing them. However, we prapred an Integrated Pest Management Plan (IPMP) with several options including traditional agronomical practices (field and plant hygiene, mulching, early planting and planting early maturing varieties), host resistance, biocontrol, use of botanical plant extracts, and use of synthetic pesticides.

However, the deployment of the different methods, especially synthetic pesticide management needs observation of regulations and policies associated with pest management. The farmers using organic manure (e.g livestock dung) and pesticides (e.g a mixture of livestock urine and ash) based on their indigenous

knowledge indicated that this method was effective, while chemical sprays were effective, which could arise from fake, counterfeit, and adulterated chemicals requiring quality control.

The main crops affected by diseases in Kihihi are maize and coffee with the main disease symptoms observed on these crops including viruses and leaf spot symptoms. In Nyakinoni, leaf spots, fruit rots, virus symptoms, rusts, wilts, and blights are observed on coffee and beans, while in Nyamirama, groundnuts, coffee, tomatoes, beans, cassava, maize, cabbage, and rice are affected by viruses, leaf spots, blights, wilts, fruit rots and rusts. The most effective disease management options include use of indigenous mixtures and sanitation (removal of diseased plants and plant parts). An integrated disease management approach shall consider a combined use of effective control methods.

The ICRP shall promote only an Integrated Pest Management Plan at the Matanda Irrigation Scheme. The IPMP implementation shallshall be systematic focusing on capacity building of input suppliers, farmers, extension workers and IPM committees; effective pest and disease surveillance; provision of advisory support; livestock pest and disease management; pesticide waste management; and PMP project management, coordination, monitoring, and evaluation.

B. Table ES 13: Contractor Environmental and Social Management Plans

Plans	Relevance	Timelines	Responsible Party
Environmental and Social Management and Monitoring Plan	The contractor guided by the ESMMP included in this report will have to detail and update it, in relation to the present project commencement period.	Upon the approval of the ESIA report by WB and NEMA add before commencement of works	MWE
Land Acquisition Management Plan	The plan will guide land acquisition and temporary construction of workers camps, storage yards, dumping sites, spoil areas, quarry site, borrow sites in respect to OP 4.12 and the national legal framework on land acquisition.	Upon approval of the RAP by WB and MoLHUD and before commencement of works	MWE
Contractors and Supply Chain Management Plan	In line with the PPDA, the plan will be the guiding document for procurement of both the contractors and the service providers.	Upon approval of the designs and software reports (ESIA and RAPs) and before commencement of works	MWE
Security Management Plan	Based on anticipated social misdemeanor, such a plan is sought to guide security protocols on the project at the different workfronts ie the workers camp, quarry sites and storage yard. The project will work closely with local law enforcement and emergency services to ensure their familiarity with the site and security protocols, develop an emergency	Upon approval by WB and before commencement of works	Contractor

Plans	Relevance	Timelines	Responsible Party
	response plan that covers incidents like fire, medical emergencies or security breaches, access control systems, surveillance systems, conducting security awareness training and incident reporting and investigation. Beyond the construction phase, MWE will adopt the same measures in managing security on site.		
Mobilization Plan	Once the project site is handed over to the contractor and before the Project commences, the contractor will need to mobilize all equipment, material, and personnel on site.	Upon contract signing and before commencement of works	Contractor and MWE
Traffic Management Plan	A Traffic Management Plan that will regulate traffic throughout the construction phase. Issues of dust, traffic jam and noise are more so regulated by this plan in place. The plan will also help protect road users and workers and keep traffic delays to a minimum through proper and clear signage.	Upon approval by WB and before commencement of works	Contractor
Grievance Management Plan	The plan will bear a Grievance Redress Mechanism (GRM) as a safeguard procedure tool to manage grievances associated and which may come up during the project implementation. The plan will describe avenues for stakeholders and community members in the project area to lodge a complaint or express a grievance against the project, its staff or contractors during project implementation. It will also describe procedures, roles and responsibilities in the grievance management process.	Upon approval by WB and before commencement of works	Contractor, DLG, MWE and WB
Occupational Health and Safety Management Plan	The project construction phase may involve risks, and an occupational health and safety plan needs to be developed so that these risks are outlined to every worker and mitigation and enhancement measures provided. It is good practise that accidents are mitigated on construction site well before they occur.	Upon approval by WB and before commencement of works	Contractor

Plans	Relevance	Timelines	Responsible Party
Labour Management Plan	It is good practice that recruitment on the construction site fulfills recommendations, policy and regulations of the government. For example, child labour, policy gender mainstreaming, local content (use of local human and other resources as much as possible), and labour influx.	Upon approval by WB and before commencement of works	Contractor
Protection of Physical Cultural Heritage	Such a plan is prepared to ensure that the cultural assets and any archaeological findings are preserved and well protected during irrigation scheme development.The contractor will prepare a chance finds procedure to guide such incidents. The CHMP will be required because there are some cultural resources within the project area e.g the Banyabitumbi community tree, located in Kihihi Town Council, Rwanga ward and is looked after by the Banyabutumbi community association (Section 5.6.16 on Sites of Cultural or Religious significance) that lies within the command area. Chance Find Procedure (CFP): Archaeological and culture items of value may be found during excavation for the trenches for the closed pipeline network distribution. In such cases t is important to prepare a procedure upon which these items will be handed if found.	Upon approval by WB and before commencement of workscommissioning	Contractor
Soil Erosion, Reinstatement & Landscape Management Plan	This will be anchored on in alleviation of anticipated degradation of soils and soil erosion due to cleared surface vegetation.	Upon approval by WB and before commencement of works	Contractor
Waste Management Plan	A lot of waste is anticipated during the pre-construction, construction, and post construction phase. These will include solid and liquid waste, hazardous and nonhazardous among others. They tend to be a threat to the community if not well managed.	Upon approval by WB and before commencement of works	Contractor

Plans	Relevance	Timelines	Responsible Party
HIV and other sexually transmitted infections (STIs) Prevention and Management Plan	The influx of labour into the community around the project area and the improvement of income as a result of employment from the project often result in behavioural disorder that may come up with social related evils such as prostitution. This tends to result in the spread of HIV and other STIs. A sensitization plan against HIV needs to be developed to fight the vice. The plan will provide a framework for Managing HIV/AIDS programs and activities amongst workers and their partners and in the community; Discouraging discrimination of persons with HIV/AIDs in the project; Raising awareness among project staff and host communities; and Encourage safe sexual behavior on the project.	Upon approval by WB and before commencement of works	Contractor
Stakeholder Engagement Plan	This plan will define a technically and culturally appropriate approach to consultation and disclosure throughout the construction phase. This will be aimed at improving and facilitating decision making and creation of an atmosphere of understanding that actively involves project-affected people and other stakeholders in a timely manner, and that these groups are provided sufficient opportunity to voice their opinions and concerns that may influence Project decisions.	Upon approval by WB and before commencement of works	Contractor
Community Liaison/ Engagement Plan	The linkage between community and the project is of great importance for the success of any project. The project needs to have a clear plan on how to link with the community. This will set a strong community relationship so as to increase awareness about the project and ensure community involvement and ownership in its implementation; ensure effective engagement with local leaders and their communities throughout all phases of the project; actively build and maintain productive working relationships, based on principles of transparency, accountability, accuracy, trust, respect, and mutual interests with affected	Upon approval by WB and before commencement of works	Contractor

Plans	Relevance	Timelines	Responsible Party
	persons and communities at large; implement methods proposed which can increase awareness and lead to the protection of project and community resources through community policing.		
Gender and Social Equity Management Plan	Gender related issues must be clearly spelled out throughout the project cycle. These may include recruitment systems, sanitation facilities and roles played by women and men. This plan will be aimed at enhancing gender mainstreaming and strengthening gender equality during the implementation of the project.	Upon approval by WB and before commencement of works	Contractor
Emergency Response and Incident Management Plan	In case of an emergency related to operation such as fire or collapse of structures, among others, a plan on how evacuation can be done needs to be developed early enough. This plan will Prepare the project team for emergency response and critical incidents; Reduce risk of severe injury and illness through appropriate management; Contain risk to limit potential harm to the environment and surrounding infrastructure; and Minimizing disruption to the community and surrounding businesses. The plan will bear an Incident Investigation, Reporting and Management Procedure.	Upon approval by WB and before commencement of works	Contractor
Spill Management Plan	Presence of potential hazardous materials like vehicle fluids and construction chemicals, contamination prevention, emergency spill response, and responsibilities associated with hazardous materials during the project requiere a plan to prepare for any accidental spill that may take place.	Upon approval by WB and before commencement of works	Contractor
Quality Management Plan	In order to achieve quality in all project operations, the contractor shall have and implement a Quality Management Plan.	Upon approval by WB and before commencement of works	Contractor
Communication Management Plan	The plan will bear the project communication strategy aimed at: Creating awareness about the project	Upon approval by WB and before commencement of works	Contractor

Plans	Relevance	Timelines	Responsible Party
	among the local communities; Encouraging community participation and support for the project; and Creation of awareness about health and safety issues like HIV/AIDS, STIs, protection against any accidents that might occur as the project is ongoing and after the project.		
Decommissioning plan	Once the project is completed, the contractor will need to demobilize all equipment, selected infrastructure, material, and personnel off site, clean the work areas of any waste and materials, and restore them as close to their original status as possible. Beyond the contractor's scope MWE will prepare an operation and maintaninance plan for the scheme and a decommissioning plan that will be implemented at the end of the project.	Upon approval by WB and before commencement of works	Contractor
Capacity Building Plan	All personnel on site will have to receive various training as per their recruitment departments.	Upon approval by WB and before commencement of works	Contractor
Pandemic Preparedness & Response Plan	Preparedness & Response Plan, tailored specifically for the project shall be prepared and implemented by the contractor to prevent, rapidly detect and effectively respond to any pendemic outbreak thereby reducing morbidity and mortality in the project.	Upon approval by WB and before commencement of works	Contractor

However, beyond the contractor's scope, implementing agency shall prepare a project decommissioning plan which shall be reviewed and approved by the regulating agency. This decommissioning plan is described in section 9.6 of this report.

18. Project Cost

The unit cost (cost per hectare) is worked out to finalize the most feasible scenario of the irrigation scheme. The unit cost per hectare along with the basic parameters is as follows: Scenario A will cost USD 11,564 per hectare while Scenario B is estimated to cost USD 8,684.

Scenario B will be constructed in three phases as stated below:

- Phase I: 2200 Ha of Command Area
- Phase II: 2220 Ha
- Phase III: 4580 Ha

The estimated cost of the ESMMP implementation and Compliace Enforcement is USD 1,688,486.

Table ES 14: Project estimated cost

Scenario	Command Area	FRL	Storage @ FRL	Cost of Scheme	Capital Cost per Ha
	(Ha)	(m)	(MCM)	(MUSD)	(USD)
Scenario-A	**4,420**	**1259**	**11.18**	**51.11**	**11,564**
Scenario-B	**9,000**	**1265**	**22.7**	**78.16**	**8,684**
ESMMP Implementation and Compliance Enforcement Costs					**1,688,486**

19. Project Period

It has been assumed that the project centers on one major asset, i.e., the irrigation system, the project period has therefore been the estimated life of this asset, which is 50 years according to the design report. The construction period is estimated to be 24 months.

20. ESIA disclosure

This ESIA will be disclosed in compliance with relevant Ugandan regulations and the World Bank Operational Policies. At the national level, once the ESIA is finalized, MWE will submit it to the NEMA for their review and approval. Once NEMA receives the ESIA reports, it will forward copies to key project stakeholders for their comments to be received within 21 days of their receipt of reports. Other copies of the ESIA will be deposited in NEMA library, Makerere University especially in the library at Makerere University Institute of Environment and Natural Resources as well in the Resource Centre in Isingiro District and in the office of the DEO Kanungu District. It is also important to note that NEMA will also disclose the Summary of ESIA on public media such as newspapers, television and radio and invite comments from the public on the project. Once NEMA receives comments on the ESIA, the Executive Director will take a decision to approve/disapprove the ESIA taking into account comments from the stakeholders as well the Agency's judgment on the likely impacts of the project. MWE will upload the ESIA and other safeguard instruments for the project onto its website https://www.MoWE.go.ug/ and invite the public to access and review the documents. The Ministry will also provide copies of the ESIA and RAP documents of the project to the public in its public library and Departments for the public to give their comments on the project. On its part, the World Bank will review, clear, and disclose the ESIA and the RAP alongside other safeguards documents in its website and make

them available to any interested persons for public access and information and welcomes comments/feedback on any issue that the Project has not been able to resolve at the country level.

21. Conclusion

Construction of Matanda irrigation scheme will provide farmers in the 9000 Ha with access to irrigation and other agricultural services, and contribute to improvement of farm incomes, rural livelihoods, food security, climate resilience, and sustainable natural resources management. This Environmental and Social Impact Assessment (ESIA) was undertaken with the aim of assessing potential impacts that the proposed project will have on both the bio–physical and social environments, with an output of an ESMMP.

The key safeguard policies and legal framework triggered by the proposed project include; National Water Policy, 1997; National Irrigation Policy, 2018; National Agricultural Policy, 2013; National Environment Act, 2019; Water Act, Cap 152, 1997; Seeds and Plant Act, 2006; Agricultural Chemicals (Control Act), 2006; World Bank's OP 4.01, Environmental Assessment; OP 4.04, Natural Habitats; OP 4.09, Pest Management; OP 4.10, Indigenous Peoples; OP 4.11, Physical Cultural Resources; OP 4.12, Involuntary Resettlement; OP 4.36, Forest; OP 4.37, Safety of Dams; and OP 7.50 Projects on International Waters.

Land acquisition and Compensation for affected property, Employment expectations and Local content, Waste management, HIV/AIDS, Impact on Physical Cultural Resources, Impact on water sources, Social ills such as family breakage, defilement, rape, theft, among others, were the major views and suggestions for careful attention during the construction phase from stakeholder engagement under this study.

Biodiversity assessments identified presence of mainly Least Concern species according to IUCN. However, the following species of conservation need are present in the project area;

- Spotted necked otter (Near Threatened), African elephant (Endangered), Hippopotamus (Vulnerable), African Lion (Vulnerable) as listed by IUCN (global) and categorized by the National Red List (WCS 2016),
- Grey Crowned Crane, Endangered species (EN) at both global and national categorisation while Regionally Threatened species in the command area included Cinnamon-chested Bee-eater and Grey-capped Warbler.
- *Labeobarbus* sp. (formerly genus *Varicorhinus*) within the Mount Rwenzori foothills, ranked as Vulnerable (VU) due to its restricted habitat range according to the IUCN Red Data Lists, was sighted in River Kiruruma. Water withdrawal will not impact these species since they are widely distributed in the project area and across Uganda.

A number of benefits will ensue from construction of the proposed irrigation scheme, including; Transformation of agriculture practice in the areas, Sustainable and optimal use of irrigation water resources, Benefit to local retail businesses, employment opportunities, Improved land conditions and household acreages, Crop diversification and intensification, Expansion of land under irrigated agriculture, Improved

food security and nutritional status, Enhanced values of the agricultural produce, and Tourism potential. However, as with infrastructure and development projects of this scale, the scheme will result in a number of both direct and indirect risks and potential negative impacts on the physical, biological, and socio-economic environment in the project area. As identified during the study, these impacts include Impact on public safety, Impact on local area water hydrology, Air and noise pollution, Degradation of soils and soil erosion, Social misdemeanor by workers, Waste generation, Occupational Health and Safety incidents, Impact on gender, Land take and Impact on project area ecology. Most of these impacts are limited to only the duration of the Pre and Construction Phase (5 years) and can be mitigated through the comprehensive measures that have been outlined in this report, which if implemented will significantly reduce or even eliminate these impacts. With respect to alleviation of anticipated negative impacts and enhancement of positive benefits for this project and Environmental and Social Management and Environment and Social Compliance Monitoring respectively., the cost estimate is USD 1,688,486. During Project implementation, the following measures are recommended in order to ensure compliance with environmental and social safeguards.

a. The Contractor, Supervising Consultant and MWE shall have a team of Environmental and Social Development Specialists to lead and oversee implementation of the ESMMP. Lead / Regulatory Agencies shall regularly visit the project as a team to ensure compliance with approval conditions in the certificates of environmental and social impacts assessment, conditions in the permits and licenses and mitigation measures contained in the ESMMP, method statements of Contractors and World Bank safeguards.

b. Mitigation measures identified within this report shall be incorporated, as far as is practically possible, within the design details, specification, and contract documents to be drawn up for the project with sound environmental practices. The ESMMP shall be incorporated in the Project Bills of Quantities such that all costs relating to environmental and social management and monitoring are included in the Project overall investment cost.

c. The Contractor, and supervising consult shall have teams of competent Environment, Health and Safety Officers (NEMA certified with certificate/diploma in OHS) and a Community Liaison Officer, among other staff, who will monitor the implementation of the ESMMP.

d. Contractors shall be required, in the tender documents, to prepare standalone Environmental and Social Management and Monitoring Plans (ESMMP). These shall be reviewed and approved by MWE to guide implementation of environmental and social mitigation measures during the project implementation phase. This shall be done before commencement of construction activities.

e. The contractor shall obtain the necessary permits and agreements as detailed in this report before commencement of construction activities.

f. MWE and Kanungu District Local Government shall undertake continuous sensitization of stakeholders and collaboration with the established farmer's Task Force through the local authorities.

g. On completion of Project works, all sites disturbed by the Project works shall be restored to as near as possible their original state as it was prior to commencement of the Project works.

h. Individual Environmental Assessments shall be carried out for the Construction camp and material borrow and quarry areas by the Contractor before commencement of works. The studies shall be spearheaded by qualified and registered ESIA practitioners.

i. Monthly reports shall be prepared by the Contractor and submitted to MWE on operational compliance with the statements/measures covered in this ESIA report.

j. As required by the National Environment Audit Guidelines and the World Bank E&S safeguards, MWE shall procure services of a NEMA registered auditor to undertake annual Environmental and Social Audits of the Project.

INTRODUCTION

1 INTRODUCTION

1.1 Background

Historical stability of Uganda's rain-fed agriculture limited the momentum by the Government to invest in irrigated agricultural development. Little attention was accorded to technological and human capacity development in irrigation. However, with gradual impacts of climate change and population pressure on land use, there is now a realization that these changes are beginning to have a remarkable negative impact on agricultural productivity.

Uganda has enormous freshwater endowments covering about 15% of the total area (37,000 sq. km out of the total area of 241,559 sq. km), of the renewable fresh water, only 1% is used for irrigation, yet world over 70% of water is used for irrigation. Ugandan irrigation potential is estimated at 3.03 million hectares (NELSAP 2012). The Government of Uganda through the Ministry of Water and Environment (MWE) with support from the World Bank is implementing the Irrigation for Climate resilience Project (ICRP, World Bank project code P163836). The project objectives are to provide farmers in the project areas with access to irrigation and other agricultural services, and to establish management arrangements for irrigation service delivery. Specifically, the project will contribute to improvement of farm incomes, rural livelihoods, food security, climate resilience, sustainable natural resources management in the proposed areas of Matanda in Kanungu District (Figure 1-1).

The project comprises three components here listed: Component 1 - Irrigation Services; Component 2 - Support services for agricultural production and value-chain development; Component 3 - Institutional Strengthening and Implementation Support.

Component 1. Irrigation Services (US$120 million). Access to irrigation is critical to allowing farmers cope with climate variability, to increase yield and intensification, and diversify towards higher value crops. Component 1 aims at providing farmers with irrigation water across various irrigation models, classified around the size of irrigation development [1] as per the National Irrigation Policy, spanning across the country.

Component 1 comprises three sub-components.

Sub-component 1.1 on Large and Medium-scale Irrigation. Large (>1,000 ha) and Medium (100 to 1,000 ha) scale irrigation schemes are established when an important water source is available in conjunction with a sizable irrigable area, offering the chance of developing economies of scale for marketing and value addition. As water might be not directly accessible across the whole irrigable area, and/or as the water source might be at a certain distance from the irrigable area and/or variable over the year, off-farm infrastructures (i.e., dams, diversions weirs, transmission pipes or canals, distribution networks) are required. The project will construct new irrigation schemes (Kabuyanda and Matanda); support the development and strengthening of management model of new (Kabuyanda and Matanda) and existing (Olweny and Agoro) irrigation schemes; and develop studies for future irrigation schemes (Nyimur, Enengo and Amagoro). Activities will include: (i) dam construction and associated head works; (ii) construction of irrigation networks (pipes, canals, hydro-mechanical equipment) up to the farm gate; (iii) construction of drainage

networks; (iv) construction of access and scheme roads; (v) construction of scheme offices, sanitation facilities, and storage facilities; (vi) construction of weather stations; (vii) consultancy services to prepare feasibility studies, detailed designs and safeguard instruments for irrigation schemes; (viii) consultancy services to monitor and control civil works; (ix) consultancy services in support of management of irrigation schemes; (x) consultancy services for environmental assessments and audits and implementation of the Environmental and Social Management Plan (ESMP); (xi) consultancy services for the rollout of Certificates of Customary Ownership; and (xii) start-up fund for Operation and Maintenance (O&M).

Sub-component 1.2 on Small and Micro-scale Irrigation. Small (5 to 100 ha) and Micro (<5 ha) scale irrigation schemes are smaller in size, relying on a nearby water source mobilized with simple and relatively low-cost infrastructure, making it possible for farmers (individually or collectively) to take charge of irrigation development and management. The project will pilot public support for the construction of farmer-led small and micro scale irrigation schemes around the two new irrigation schemes (Isingiro District around Kabuyanda and Kanungu District around Matanda) and in areas close to Kampala characterized by high marketing potential (Mukono, Wakiso and Mpigi Districts), adopting a value chain approach. Activities will include: (i) construction of small water retention facilities and associated head works; (ii) drilling of wells and boreholes; (iii) construction of small irrigation networks (pipes, canals, hydro-mechanical equipment); and (vi) consultancy services to prepare designs, safeguard instruments and for monitoring and control of works.

Sub-component 1.3 on Integrated Catchment management. It will develop and implement integrated catchment management interventions for the two new irrigation schemes (Kabuyanda and Matanda), to improve the sustainability of the schemes, including the restoration/reforestation activity in Rwoho CFR (Kabuyanda). Activities will include: (i) consultancy services to prepare integrated micro-catchment management plans; (ii) implementation of identified watershed management measures from the micro-catchment management plans; and (iii) restoration/reforestation activities.

Component 2. Support services for agricultural production and value-chain development (US$32.6 million)
Component 2 aims to support farmers carrying out on-farm irrigation, accessing production and value addition knowledge and skills, and developing sustainable market access. The project will support farmers in increasing their knowledge using a Farmer Field School (FFS) approach, increased access to inputs (improved seeds, fertilizers), on-farm irrigation technologies, machineries and postharvest and agro-processing infrastructures through the use of smart subsidies and consultancy services.

Component 2 will comprise of two sub-components.
Sub-component 2.1 on On-farm Production and Productivity. It will provide support to farmers and farmers' groups for production and productivity improvement at the farm level in the new irrigation schemes (Kabuyanda and Matanda), in existing irrigation schemes (Olweny and Agoro), in small and micro irrigation schemes (Isingiro, Kanungu, Mukono, Wakiso and Mpigi Districts) as well as in the area of the proposed future irrigation schemes of Nyimur, Enengo and Amagoro. Activities will include: (i) consultancy services to create and strengthen farmer groups, provide extension services, facilitate access to inputs, promote good agricultural practices, sustainable land management practices, and integrated pests and disease management; (ii) matching grants to facilitate access to inputs (seeds, agro-chemicals); (iii) matching grants to facilitate access to on-farm irrigation technology; and (iv) consultancy services to monitor and control civil works.

Sub-component 2.2 on Value Addition and Market Linkages. It will provide support to farmers' groups for value-chain development and strengthening and establishment of market linkages. Activities will include: (i) consultancy services to create and strengthen linkage with value chain actors in improved post-harvest handling, agro-processing, access to financing services, access to markets and market information; (ii) matching grants to facilitate access to equipment; and (iii) purchase of small goods.

Component 3. Institutional Strengthening and Implementation Support (US$10 million)
Component 3 will comprise of two sub-components.

Sub-component 3.1 on Institutional Strengthening. Activities will include: (i) short-term studies on management models in irrigation, tariff structures, and prerequisites for financial sustainability; and (ii) capacity building, training and study tours.
Sub-component 3.2 on Implementation Support. **Activities will include:** (i) hiring of individual consultants for the Project Support Team (PST); (ii) purchase of project implementation goods and services (ICT Equipment, software, vehicles); (iii) travel costs and allowances; and (iv) Monitoring and Evaluation (M&E) costs.

Box 1-1A: Physical Progress of Kabuyanda Irrigation Scheme:

There are two (2) works contracts that are being implemented under the Kabuyanda Irrigation Scheme:

(i) Kabuyanda Dam Works

The cumulative progress of the construction of Kabuyanda earth dam is estimated at 21% as of July 2024.

(ii) Irrigation Pipe Network. Support services for agricultural production and value-chain development

Construction of the pipe network commenced in April 2024 and the contractor is still undertaking the requisite preliminary activities.

Box 1-1B: E&S Performance of Kabuyanda Irrigation Scheme:

Below is the summary of the E&S Performance of Kabuyanda Irrigation Scheme:
Key achievements under safeguards management.

ix. The Ministry of Water and Environment (MoWE) has a dedicated safeguards team including the Environmental Specialist, Social Safeguards Specialist, Sociologists and Environmental Officers to supervise E&S aspects of Kabuyanda Irrigation Scheme.
x. The Resident Engineer has also deployed Environmental Expert and Social Development Expert at site to undertake daily supervision and enforcement of E&S requirements of the contracts.
xi. The Contractors have hired and deployed qualified and competent Environmentalists, Sociologists, Health and Safety Officers, Doctors-on-Call and Site Nurses headed by the Project Managers to implement the E&S plans at site.
xii. The Contractors have prepared and are now implementing the Contractor's Environmental and Social Management Plans (C-ESMPs) that were reviewed and cleared by the World Bank.
xiii. Bi-weekly safeguards implementation progress review meetings are held with the Dam and Irrigation network contractors. These meetings are attended by the Contractors, Resident Engineer, Third Party Safegaurds Monitoring and Supervision Consultant and the Ministry of Water and Environment staff.

xiv. The Ministry of Water and Environment (MoWE) undertakes quarterly E&S Safeguards Implementation Support Clinics for both the Dam and pipe network contractor in which contractors undergo hands-on training on E&S requirements, implementation and record keeping.

xv. Implementation of Priority catchment management measures will commence by October 2024

xvi. Restoration of 1,000 Hectares of Rwoho Central Forest Reserve to mitigate the 100.2 Ha severed by Kabuyanda Dam works has been completed.

Other Technical Assistance (TAs) Consultancies under E&S

MoWE has also hired and deployed the following TA to enhance safeguards compliance;

- Gender Based Violence/Violence Against Children (GBV/VAC) Consultancy Firm
- HIV/AIDS Consultancy Firm
- Grievance management and Stakeholder Engagement Consultancy Firm

The above firms support MoWE in sensitizing contractors' workers, communities and local authorities on social safeguards risks and mitigation measures in line with their contractual obligations.

Third Party E&S Safeguards Supervision and Monitoring

The Ministry of Water and Environment (MoWE) awarded the contract for Environmental and Social safeguards supervision and monitoring to JBN Planners and Consults that became effective in April 17, 2023. This contract will cover the construction and defects liability period (DLP) of the Kabuyanda Iirrigation Scheme works. JBN has undertakes the following;

- Supported MoWE in the review of the Contractor's Environmental and Social Management Plans (C-ESMPs) prior to clearance by the World Bank.
- Revieweved the screening, scoping and ESIA reports for the Contractors' auxiliary sites such as workers' camps, material borrow sites and batching plants prior to approval by the National Environment Management Authority.
- Undertakes impromptu, monthly and quarterly site inspections and prepares reports thereof.
- Attends monthly site meetings and other safeguards meetings organized by MoWE.
- Undertakes independent water quality tests, biodiversity assessments and stakeholder engagements to ascertain the compliance of the Contractors to E&S requirements.

World Bank Rating of E&S Performance of Kabuyanda Irrigation Scheme

The World Bank Project Implementation Support Mission of March 2024 rated the E&S performance of Kabuyanda Irrigation Scheme as **Satisfactory**.

1.2 Project developer

Project developer	**Water for Production (WfP) Department** Ministry of Water & Environment (MWE) Plot 11/28 Port Bell Road – Luzira P.O. Box 20026, Kampala
Contact person	**Permanent Secretary** Ministry of Water and Environment
Project Funder	**The World Bank**

	Rwenzori House, Plot 1, Lumumba Avenue, P.O. Box 4463 Lumumba Avenue, Kampala

1.3 Terms of Reference

The ESIA report has been developed based on the terms of reference that has been reviewed and cleared by both the World Bank and NEMA. The conditions thereunder have been sufficiently addressed.

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

NEMA House
Plot 17,19 & 21, Jinja Road.
P.O.Box 22255, Kampala, UGANDA.

Tel: 256-414- 251064, 251065, 251068
342758, 342759, 342717
Fax: 256-414-257521 / 232680
E-mail: info@nemaug.org
Website: www.nemaug.org

NEMA/4.5

26th August, 2019

The Permanent Secretary
Ministry of Water and Environment,
P.O. Box 20026,
KAMPALA.

Tel: +256 (0) 414 505942

REVIEW OF THE SCOPING REPORT AND TERMS OF REFERENCE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED MATANDA AND ENENGO IRRIGATION SCHEMES IN KANUNGU AND RUKUNGIRI DISTRICTS

The above subject matter refers, we note that you submitted a single TOR for two assessments. This is to remind you that two independent assessments will have to be undertaken, and hence two ESIA reports submitted to this Authority for review. While undertaking the assessment, and in addition to your proposal, we advise that you also take the following into consideration during the assessment.

a) Provide a detailed description of the contemporary baseline information (biophysical and socio-economic) of the project site and its environs;

b) Ensure that the report has accurate GPS coordinates (UTM) of the boundary of the project area, including a legible site layout plan of the project area, and ensure it shows all the areas supposed to be excluded from use;

c) Ensure that comprehensive consultations are carried out with all key stakeholders, including the local community around the project area, and that the views/concerns of the stakeholders are well documented and integrated in the ESIA report;

d) Carry out soil analyzes based upon a spatially exhaustive soil sampling strategy, and ensure to make use of the findings in the report.

e) In regard to the (d) above, enlist the services of a soil scientist to assist interpret soil data and advise as necessary.

f) Undertake consultations with scientists based at the National Agricultural Research Laboratory (NARL), Kawanda, on the suitability of the area for the rice cultivation and make use of this guidance in the ESIA report;

g) Engage with the production departments of Kanungu and Rukungiri districts in order to ensure the project is in harmony with the plans of the said local governments.

h) Provide a succinct description of all the project components.

i) Be sure your presentation of environmental impacts considers surrounding developments, of similar or larger magnitude, whose operations are likely to amplify impacts due to the proposed development;

j) Consider any other environmental aspects/concerns which may have been overlooked during the preparation of the scoping report and TOR, and include an evaluation of such concerns in the ESIA report;

k) Present an exhaustive Environmental and Social Management Plan, discussing ways in which potential environmental impacts will be mitigated at every stage of the project, including the responsibility centers and projected cost of mitigating each impact as will be defined; and

l) Include in the ESIA REPORT the total project (investment cost) covering all the components of the project.

m) Attach to the ESIA report legible and authentic evidence of ownership of the land you plan to develop;

This is therefore to recommend that you proceed with the ESIA for the proposed project. Please note that this is NOT a certificate of Approval and does not constitute permission to start project implementation.

Dr. Jerome Lugumira
For: EXECUTIVE DIRECTOR

Cc: Eng. Dr. Lammeck Kajubi (Team Leader)
27 Binayomba Road, Bugolobi
P.O. Box 22428
KAMPALA.
Tel: 0712 403357 / 0782580480

1.4 Project location

Matanda irrigation scheme will be located in southwestern part of Uganda, in Kanungu District with a command area covering five (5) sub counties/and respective number of villages in each parish (Table 1-1 and Figure 1-1)., Kinkizi, Nyamirama, Nyanga Sub counties, Kihihi Town Council, Kihihi Sub County on the left-hand side and Nyakinoni Sub County on the right-hand side. The irrigation system will impound Kiruruma River waters with the dam and reservoir in three (3) sub counties of Kanyantorogo, Kirima, and Katete. The proposed command area extent of the scheme is 9000 ha.

Appendix B presents the detailed list of all scheme villages.

Table 1-1 Matanda Irrigation scheme administrative boundary (Kanugu District)

SUBCOUNTY	PARISH	NO OF VILLAGES @ PARISH
Reservoir Area		
Katete	Kishuro	Mutojo
		Ibumbwe
	Nyakishojwa	Nyakishojwa
		Nyaruhanga
Kihanda (formerly under Kirima subcounty)	Kihanda	Ibarya
	Kihanda	Nyakarambi
Kanyantorogo	Kishenyi	Kanyungutsi
		Nyambare
Command Area		
Kihiihi	Kibimbiri	13
	Rushoroza	10
	Kabuga	6
Kihiihi Tc	Rwanga Ward	10
	Nyakatunguru Ward	14
	Kihiihi Town Ward	8
	Bihomborwa Ward	13
Nyakinoni	Kanyambeho	5
	Karubeizi	9
	Nyakinoni	2
	Samaria	6
Nyamirama	Mashaku	3
	Ntungwa	3
	Nyakashure	5
	Kigarama	3
	Rushaka	5
Nyanga	Bukorwe	5
	Nkunda	2

SUBCOUNTY	PARISH	NO OF VILLAGES @ PARISH
	Nyanga	2
Total 5 Sub-counties	**19 Parishes**	**124 Villages**

1.5 Rationale of the Project and Assignment

To increase productivity and resilience to climate change and diminish reliance on erratic rains, the Government of Uganda (GoU) is prioritizing modernizing agriculture through development of irrigated agriculture. Through the Ministry of Water and Environment's (MWE) Water for Production (WfP) Department, the Uganda government seeks to support farming communities in Matanda with irrigation schemes aimed to improve agricultural productivity, food security and livelihoods through irrigation. This intervention would enable sustainable agricultural production all-year round and alleviate socio-economic impacts of low productivity in rain-fed agriculture. The scheme design is hinged on community-based participation with the districts and sub-counties as focus of implementation, and the private sector as main technical service providers. The focus therefore was to develop the identified sites into modern irrigation schemes with farmer based sustainable institutional management arrangements. The purpose of the Environmental and Social Impact Assessment (ESIA) study was, therefore, to ensure that if the project is undertaken, it is undertaken in such a way that there is minimal or no adverse impact on the physical, biological, cultural and socio-economic environment of the proposed project area and vicinity.

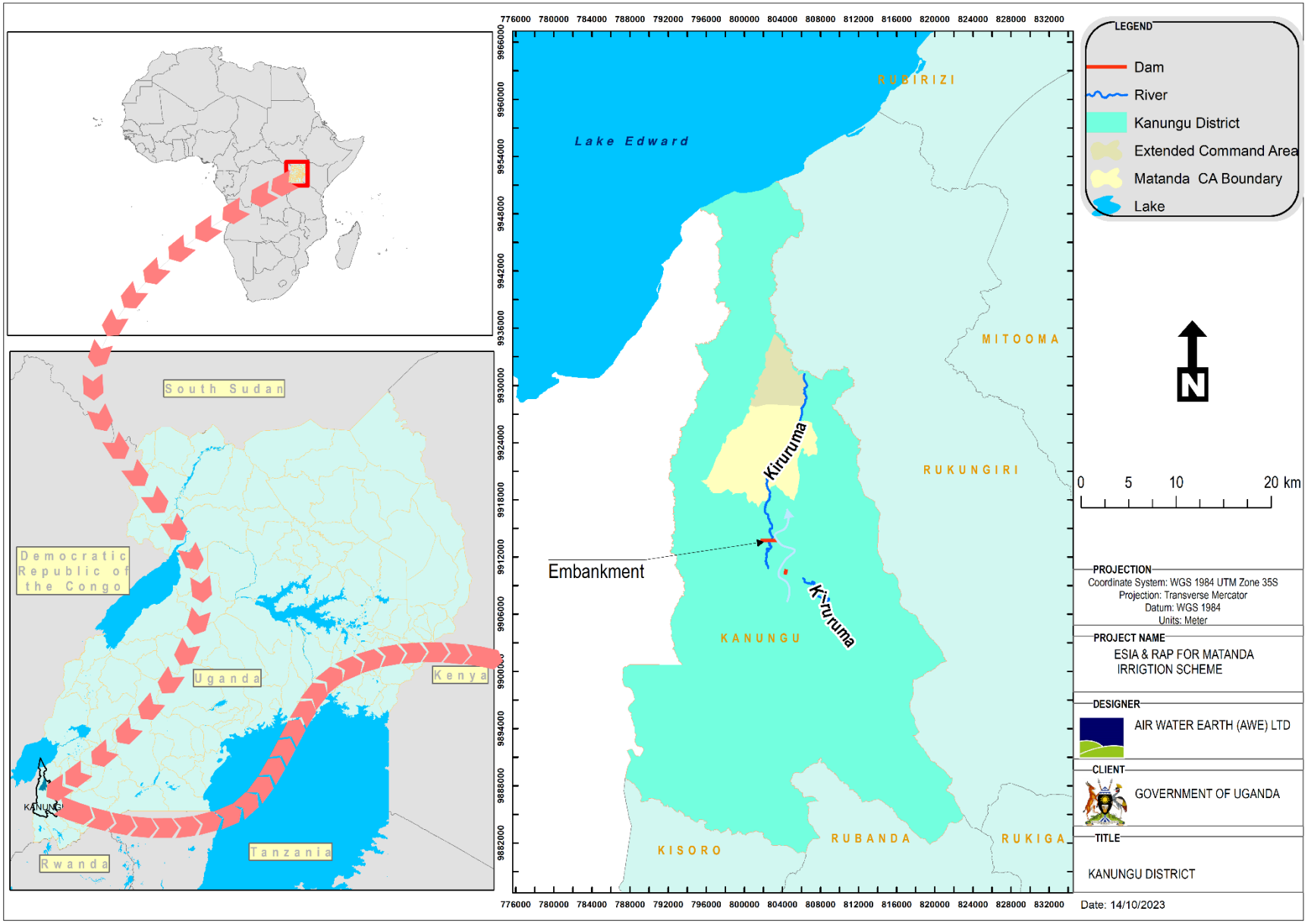


Figure 1-1: Location map of the proposed Matanda irrigation scheme and main servicing river/stream in Kanungu district

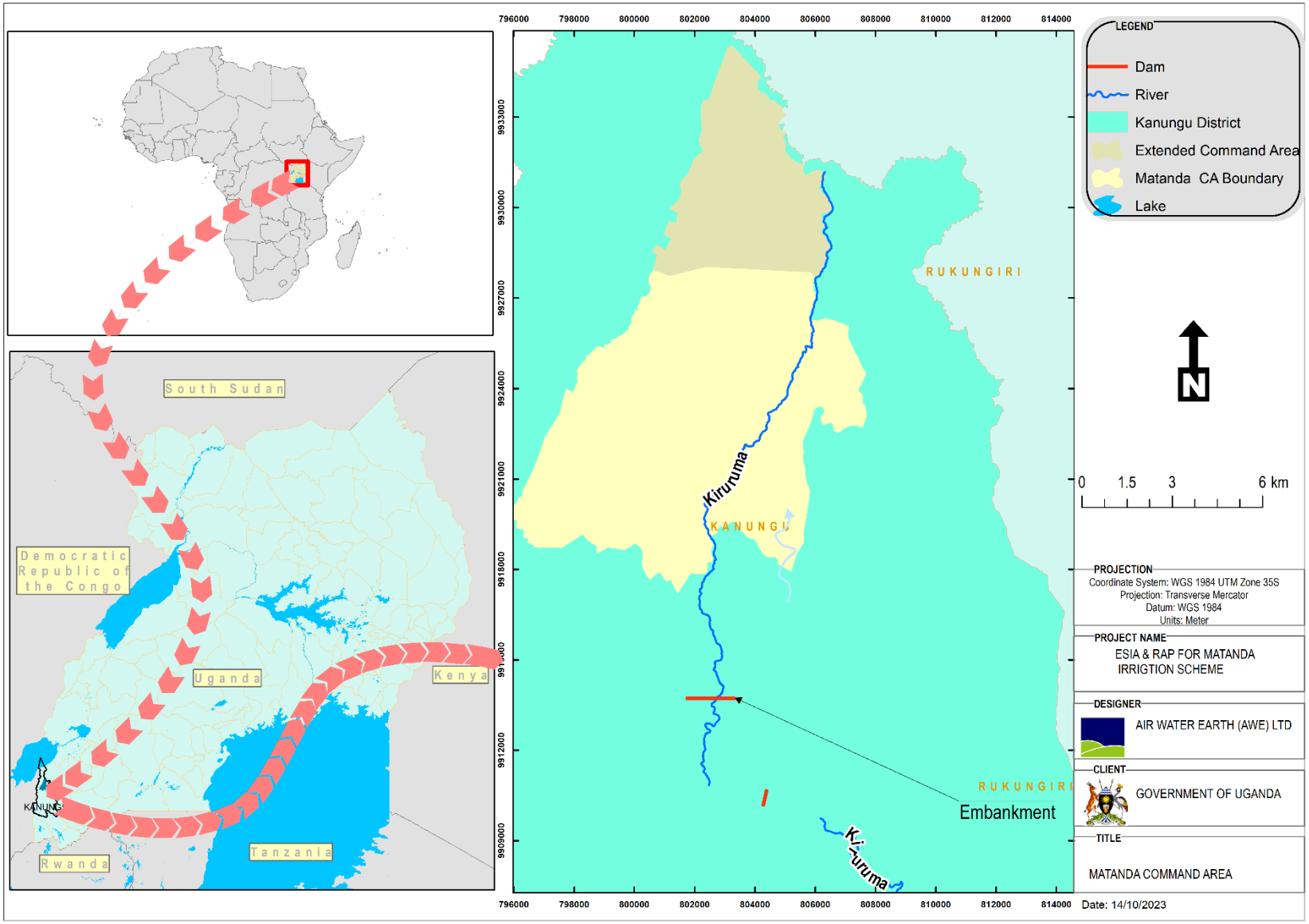


Figure 1-2: Location map of the proposed Matanda irrigation scheme abstraction and command area

1.6 Objectives of the ESIA

The general objective of the ESIA is to identify and assess the potential environmental and social impacts (both positive and negative) of the proposed Matanda Irrigation Scheme prior to, during and after infrastructure construction, and propose measures to eliminate/minimize negative impacts, while enhancing the positive impacts.

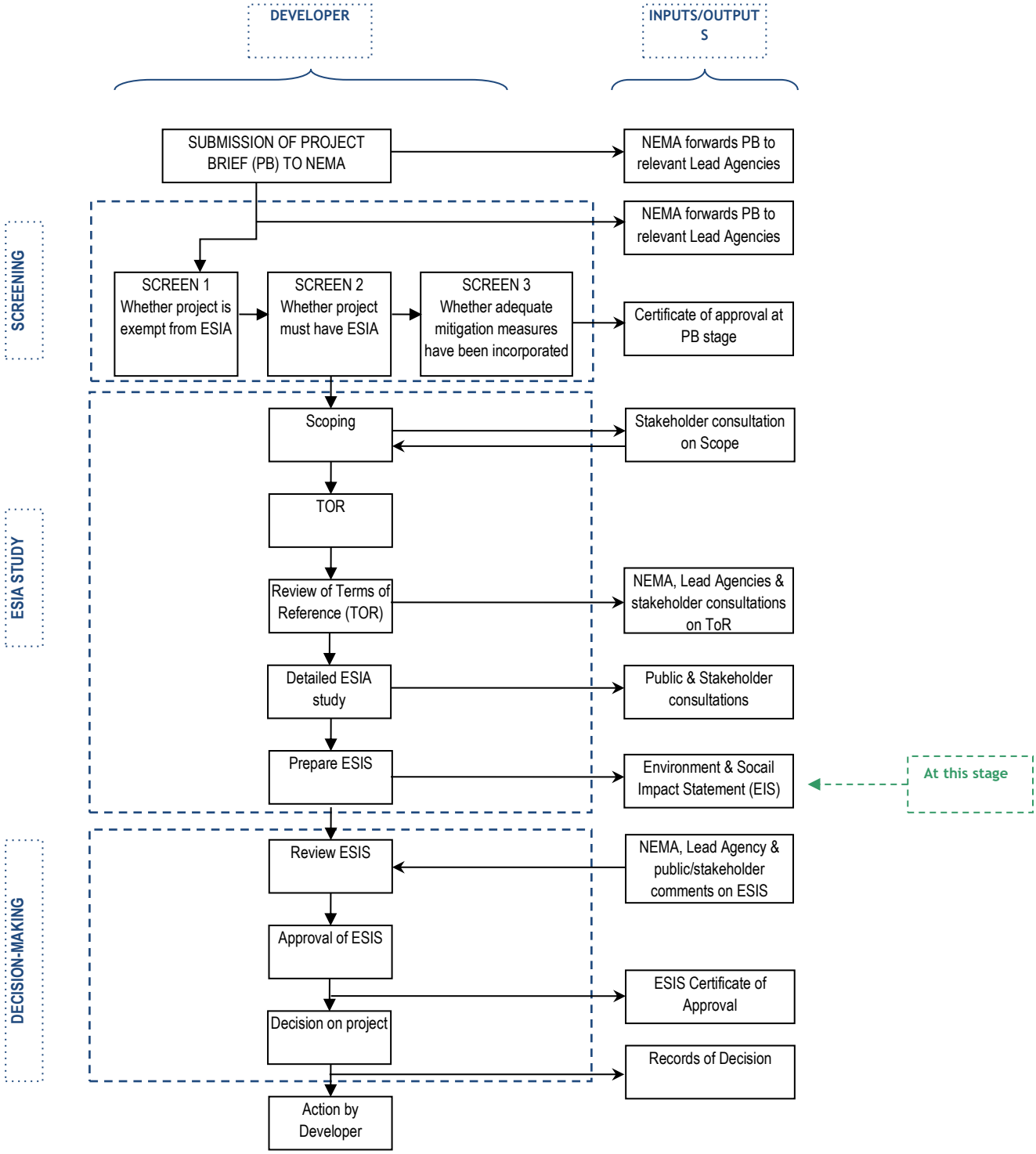
The specific objectives of the ESIA are:

a. Identify any legislation/safeguard policies that are triggered because of the proposed project activities.
b. To examine the existing environmental and social baseline conditions of the proposed Project area.
c. To obtain stakeholders' views on the proposed Project for consideration during Project design.
d. To identify and assess the risks and potential significant environmental and social impacts of the proposed project.
e. To recommend measures that can be taken to avoid, offset or reduce the potential adverse environmental and social impacts of the proposed project.
f. To recommend measures that can be undertaken to enhance the positive potential environmental and social impacts of the proposed project.
g. To describe and analyze any project alternatives that were being considered and recommend the best alternative with most benefits and least costs in terms of financial, social and environmental considerations.
h. To compile an Environmental Impact Statement incorporating an Environmental and Social Management and Monitoring Plan (ESMMP) which outlines the mitigation/enhancement, monitoring, consultative and institutional strengthening measures to prevent, minimize, mitigate, or compensate for adverse environmental and social impacts and to enhance beneficial impacts, costs of the measures and monitoring requirements.

1.7 ESIA Requirements

The process for ESIA in Uganda is described in the flow diagram in Figure 1-3. This Environmental and Social Impact Statement (ESIS) was therefore prepared in accordance with the requirements stipulated in the Environmental Impact Assessment Regulations, 2020 and Schedule 5 of the revised National Environment Act, 2019. The ESIA analysed the potential environmental impacts of the project and proposed mitigation measures and monitoring programs to ensure that environmental impacts are avoided or kept to minimum. The mitigation measures and monitoring programs were compiled into an Environmental and Social Management and Monitoring Plan (ESMMP) that form part of the ESIS.

In reference to WB OP 4.01/ ESS 1 and also to Uganda's ESIA process, the study has been accomplished through the various levels shown below:



**Source: NEMA, (2002). ESIA Reference Manual.*

Figure 1-3: ESIA process in Uganda

However, the project is to be implemented through a phased approach. If any of the phases is initiated after five years of the ESIA permit period, a review shall be undertaken to update the ESIA and to acquire the requisite permit.

PROJECT DESCRIPTION

2 PROJECT DESCRIPTION

The scope of the technical works for the proposed project has been categorized into three phases, including; Design and planning, Construction, and Operation phase.

The Dam for Matanda scheme is located on river Kiruruma, the proposed intake point for Matanda irrigation scheme drains a catchment area of approximately 137.9 km2.The area stretches through the sub-counties of Kanungu TC, Rutenga, Rugyeyo, Kirima, Kanyantorogo, Kambuga and Katete. It comprises a number of small tributaries that join to form River Kiruruma. The proposed project consists of a Roller Compacted Concrete (RCC) dam, 32m high from foundation level creating a reservoir with storage capacity of 22.7 MCM to serve a total irrigation command area of 9000 hectares. Part of the irrigation command area borders the Queen Elizabeth National Park covering a stretch of 15km. An electric fence is under construction by UWA covering the Queen Elizabeth National Park boundary.
Installation of an electric fence along the park and project area by the Uganda Wildlife Authority (UWA) under the World Bank-funded Investing in Forests and Protected Areas for Climate Smart Development-(IFPA-CD) Project - P170466. is over 80% complete. It is designed to protect the wildlife from the command area.

2.1.1 Seismology

The proposed site lies far from seismic zone 1 of the seismic zoning of Uganda, implying that there's a high risk of earthquake occurrence at the site (Seismic Code of Practice for Structural designs; UNBS, 1st Edition: June 2013).

Seismic/Dynamic analysis was considered in the design of the dam to determine the response of the dam to seismic forces. Simulations for earthquakes were done and the dynamic response of the dam structure determined. This response includes displacements, and both tensile and compressive stresses.

Return Period for Seisimic Analysis: According to current practice large dams have to be able to withstand the effects of the Maximum Design Earthquake (MDE) and the Probable Maximum Flood (PMF). These are the most severe events that could affect the safety of a dam, and they are considered to have a return period of several thousand years. Matanda was designed for PMF >10,000-year floods. The value of the return period corresponding to the respective PGA was obtained from Cheriberi & Yee (2022). For the Matanda dam site, the MDE-PGA = 0.15g used is associated with 10% exceedance probability for 50years.

The hazard potential for the proposed dam is related to its location upstream of Kihihi Town. The current hazard potential is low because the town is far from the river course and is at higher elevation compared to the river valley.

2.1.2 Soil Survey and Land Suitability Assessment

2.1.2.1 General Suitability for Irrigation

Haplic Ferralsols and Acric Ferralsols were highly suitable for irrigation with no major limitation and Rhodic Ferralsols showed moderately suitability with limitation due to textural class (S2(t). Very high and low values of K_{sat} are not favorable for irrigation. The high values can lead to a loss in water due to percolation and the low values can result in huge volumes of runoff and erosion. K_{sat} is an important soil property to many soil water-related investigations such as water conservation, irrigation design, drainage and general transport phenomena in soils. Ferralsols have high structural stability. The relatively low Ksat can be attributed to the formation of stable micro-aggregates. The topsoil macro-aggregates can be subjected to degradation due to human activities such as tilling which decreases K_{sat}.

Arenosols (Humic) S3(t,ks), Gleyic vertisols S3(t,ks), Fluvisols S3(t,) were also marginally suitable and Gleyic Planosols N1(sd,S) is marginally Not suitable. The first two soils; Arenosols (Humic) and Gleyic vertisols S3(t,ks), had a soil texture, and Ksat limitation. On the same note; Fluvisols S3(t,) had limitation due to texture S3(t,) while Gleyic Planosols N1(sd,S) was limited due soil depth (sd) and slope(S). Texture determines the rate at which water shall be applied, how much shall be applied and how often irrigation shall occur. For the case of Gleyic Vertisols which contains much more clay than other soil types, water will infiltrate slowly and applying large volumes quickly will lead to a runoff. However, they can store a large volume of water and therefore requires less frequent irrigation. Good soil structure allows for improved infiltration and drainage. It also enhances root growth. Poor structure reduces infiltration and water holding capacity and will make irrigation more difficult to manage.

Leptosols are Not suitable due to a soil depth limitation (sd). Soil depth determines the potential rooting depth of plants to be grown and any restrictions within the soil that may hinder rooting depth. Any discontinuities in the soil from layers of sand, gravel or even bedrock physically limit rooting depth and hinder irrigation. It can also create problems when using irrigation.

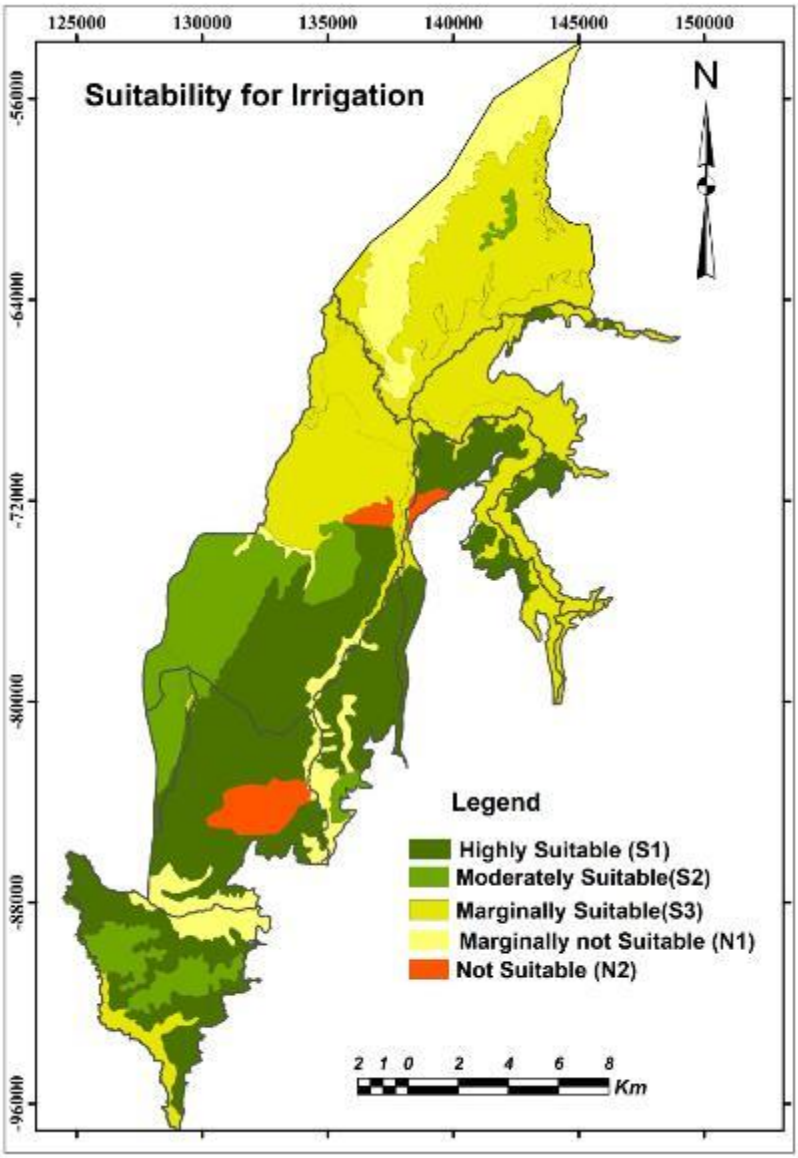


Figure: Shows the map of general land Suitability for Irrigation

2.1.2.2 Soil Fertility and Land Management under Irrigation

Soil fertility refers to the inherent ability of soils to provide sufficient and right quantity vital nutrient to plant for their most favorable growth and it is one of the key components to determine productivity. Nitrogen is only second to water affecting the yields of most of the crops. The interaction between nitrogen and irrigation water has a significant effect on crop yields.

Soil nutrient status of the project site is varied from point to point and depth to depth as expected. N showed 50% of the sample having moderate values and 40% low levels of N and the remaining 10% high in N content. The soils are low in available P with almost 80% of the samples below the critical values and the remaining

20% ranging between medium-high levels of P in the soils. K levels in the soil range from very low to medium. In exception of few cases; the level of Ca in the soils is moderate/medium. For increased and sustainable crop yields supplementary nitrogen and phosphorus fertilizer and organic manures might be required with the experience of other irrigation schemes in Uganda.

Therefore, field trial experiments for calibration of nutrient requirements for crops by agricultural researchers and adaptation trials on farmer's plots are required. The soil tests shall be calibrated by correlating them with the yield results of a field experiment. The continuous field experiment in the specific area provides the basis for fertilizer recommendation.

In this paragraph, we suggest the following fertilizer rate for rice crop that has been grown in many irrigation schemes in Uganda based on different National Agricultural Research Institutes' and JICA recommendations.

Apply 25 kg of DAP (18-46-0) and 25 kg of Urea (46-0-0) before final harrowing. Apply 25 kg of urea at panicle initiation stage (65-70 days after sowing) as a top dressing. After top-dressing, irrigate the field and keep 2-3 cm standing water and keep water in the field for one week to avoid fertilizer runoff.

After transplanting keep the shallow depth of water around 2 cm for one week and keep the field at saturation up to maximum tillering and keep 3 to 5 cm of standing water in the field till hard dough stage of the seed and stop irrigation/drain the water a week before harvest.

Supplying of optimum quantities of nutrient N, P and K with farmyard manure have beneficial effects on the physical and biological situations of the soils. In order to manage & maintain soil fertility in the project area, organic manure and inorganic fertilizers shall be utilized together. The application of nitrite-containing fertilizers for crops grown under surface irrigated agriculture and water-logged soils results in a considerable amount loss of N due to its denitrification. Therefore, nitrogen fertilizers must be given a split application depending on the critical growth stage of the crop. Application of green-manure increases utilization of phosphorus by the crop not from the added fertilizers but also from the reserve supplies of soil phosphorus. The application of organic matter also improves the CEC of the soil.

2.1.2.3 Recommendations

Most of the crops are suitable for most of the soils identified. However, appropriate management is required for all the soil types and more attention shall be paid to soils with serious limitations. A summary of management options is detailed below.

- Application of manure and inorganic fertilizers applied at guideline rates based on the crop type and crop physiological stage in all the soil types. In sandy soils, fertilization with organic manures is very essential. Application of organic manures can supply nutrients in slowly available forms and improve soil physic-chemical properties.
- Controlled application of irrigation water. Drip irrigation is essential because the large pore spaces in sandy soils can lead to a loss in the large volumes of irrigation water.

- Increase the slope for furrow irrigation on sandy soils (Arenosols, Planosols, and Fluvisols) so that water can move a long distance before it completely infiltrates in a short distance.
- Applying a moderate amount of water and in a slow paste especially on clayey soils (Gleyic Vertisols) due to its high water holding capacity and low infiltration rates.
- Use of broad beds especially on clayey soils (Vertisols) because these soils are prone to waterlogging especially in the rainy seasons.
- Organic matter levels need to be improved and maintained especially under Arenosols by addition of organic manures, use of cover crops and leguminous crops.
- Tree planting and animal grazing especially for shallow soils; Plinthosols and Leptosols.

2.1.3 Agro-Economic Feasibility Study of Matanda Irrigation Scheme

2.1.3.1 Introduction

The farmers in Matanda practice subsistence agriculture. For Matanda, the main typologies are Rice, Cereal/legume (Field Crops), and Coffee/Banana dominated fields. Land tenure system is mainly customary in both schemes across all typologies. In Matanda, the percentages of farmers with customary land are 79.2%, 75.9%, and 71.8% for rice, cereals and perennials.

The major crops grown by the farmers in the command area include rice, maize, beans, groundnuts, millet, coffee, and banana. Besides, sweetpotato, cassava, tomatoes, watermelon, cabbages and sugarcanes are also grown but by very few farmers. Both crop rotation and intercropping are dominant cultural practices applied in Matanda and across the different farm typologies. Nevertheless, the cropping pattern is sometimes not well sequenced as in some cases, crops in the same family are intercropped or rotated following each other such as beans with groundnuts. Consequently, farmers do not generally enjoy the benefits of intercropping and crop rotation.

Overall, the cropping calendars for the crops grown follow the rainfall regimes in Matanda. However, these calendars reveal poor adoption of Good Agronomic Practices (GAPs). For instance, they are characterized with: weeding only once in the entire crop production cycle; rarely are pests and disease managed; there is very limited use of productivity enhancing technologies particularly fertilizers; and although improved seed is used, most of it is recycled from the previous season.

2.1.3.2 Existing crops

The major crops grown by the farmers in the command area include rice, maize, beans, groundnuts, millet, coffee, and banana (Tables 5). Besides, sweetpotato, cassava, tomatoes, watermelon, cabbages and sugarcanes were reported to be grown but by very few respondents. Rice is grown as sole crop. In contrast, other crops i.e., maize, beans, groundnuts, coffee and millet are cultivated as both sole and as intercrops within the various typologies in the two schemes. Generally however, sole crops registered higher yields compared to when they are grown as intercrops. Nevertheless, for both sole and intercrop systems, the productivities for all crops across all the farm typologies in Matanda are very low compared to the potential yields. For instance, the potential yields (Mt/ha) are over 2.4 for groundnuts and for beans, 4.5 for rice and for coffee, 3.5 for open pollinated maize variety-Longe 5, and over 6.0 for hybrid maize. The low productivities can be attributed to several factors including limited adoption of Good Agronomic Practices (GAPs) such as

use of appropriate rotations, recommended weeding regimes and pests and disease control; decreasing soil fertility coupled with inadequate use of productivity enhancing technologies such as fertilizers, pesticides and improved seed.

2.1.4 Value Chain Actors in the command area

2.1.4.1 Technical advisory services

Farmers received capacity building support on different issues from a number of organizations (Table 15). However, across the issues supported, the percentage of farmer beneficiaries is less than average, and the service was provided by NAADS and the District Local Government (DLG) and Raising A village NGO. Worse still, no farmer mentioned to have received support of insurance (Table 15).

Table: Percentage of farmers who received trainings on different issues and respective support institutions

Type of support	Percentage of farmers receiving the support	
	%	Institutions providing the support
Crop production training	46.7	NAADS, DLG, Churches, Raising A village NGO, Micro finance Kadevi, USAID, Coffee shop, UCDA, R.T.V, OWC, NARO, Farm Africa
Post-harvest training	28.8	NAADS, DLG, Raising A village NGO, USAID, Coffee shop, UCDA, R.T.V, OWC, Farm Africa, Coffee Academy, Tobawo Shop
Irrigation	6.6	NAADS, DLG, Raising A village NGO, Church
Marketing	21.3	NAADS, DLG, Raising A village NGO, USAID, Coffee shop, Cooperative, R.T.V, OWC, Bank, Farm Africa, Coffee Academy
Market information	2.8	NAADS, Radio, Raising A village NGO,
Financial training	30.2	NAADS, Raising A village NGO, AWEC, Coffee Academy, SACCO and VSLA
Insurance	0.0	
Business Development	11.3	NAADS, USAID, Raising A village NGO,

2.1.4.2 Agro-input dealers

The agro dealers whose businesses are located in the project area purchase inputs from wholesalers majorly in container village in Kampala, and sell them mainly to individual farmers. In addition, the agro dealers offer advisory services to the farmers. The major inputs stocked by input suppliers and demanded by the farmers are pesticides followed by spray pumps, while herbicides and fertilizers are least demanded as they are considered to be expensive especially for the small-scale farmers in the area. Although the farmers mentioned and use improved seed, this is normally home saved which they recycle for the subsequent planting, thus it is stoked in low quantities by the agro dealers. Worse still, agro-dealers rarely stock water for production inputs. Generally, the volume of agro inputs demanded by the farmers during a normal season is more than three times to that of bad season.

2.1.4.3 Produce buyers/traders

Farmers in both schemes across the typologies and commodities usually sell their produce individually and mainly to village traders (Table 16). The latter in turn sell mainly to large buyers who majorly deal in grains and pulses such as maize, beans, groundnuts, millet etc. Both the village traders and large buyers purchase and sell produces using informal arrangements. Most of the large buyers have warehouses located within the project area and sell to major markets in Kampala, Rwanda and Tanzania although some sell to schools and hotels in Kanungu district. Some of the traders also offer services of processing, and market information on commodity pricing and marketable products.

Table: Buyers of farmer produce

Commodity	Buyer	Rice	Cereal/ Legume	Coffee/ Banana
Rice	Village trader	69.7	62.3	71.4
	Wholesaler	27.3	35.1	21.4
	Others	3.0	2.6	7.1
Beans	Village trader	89.7	71.7	65.0
	Institution	0.0	0.0	0.0
	Wholesaler	6.9	24.2	25
	Others	3.4	4.0	10
Maize	Village trader	87.8	71.4	76.8
	Institution	2.4	1.0	1.9
	Wholesaler	7.3	24.5	17.4
	Others	2.4	3.1	3.9
Coffee	Village trader	76.5	55.1	50.0
	Institution	8.8	2.2	0.0
	Wholesaler	14.7	40.4	20.8
	Others		2.2	29.2
Millet	Village trader	100	76.0	83.3
	Institution	0.0	0.0	0.0
	Wholesaler	0.0	24.0	16.7
Ground nuts	Village trader	81.8	52.9	54.5
	Wholesaler	18.2	37.3	18.2
	Others	0.0	9.8	27.3

2.1.4.4 Financial Services

The team identified a number of Financial Service Providers (FSPs) that include Commercial banks, SACCOs, Farmer groups, and VSLAs. SACCOs provide loans to more farmers than any other category in Matanda with respective percentages of 37.8 and 35.3. In contrast, the findings show that only 9.1% of the individual respondents from Matanda access loans from commercial banks (Table 17). It was reported by the key informants that the entire watershed covering Matanda, has only Stanbic bank, while in the districts there are other banks such as Centenary and post banks, but these are located in Kanungu town which is about 30Km from the command area. On the other hand, SACCOs, Farmer Groups and VSLAs are located within the community. On average, farmers pay interest per year of 43.2% from the informal organisations i.e., Farmer Groups and VSLAs, while commercial banks the interest rate is 24%. However, the majority of

farmers do not access credit from commercial banks due to a lot of stringent conditions that are not readily affordable by small scale farmers.

Table: Sources of credit for the farmers

Credit source	Matanda
Commercial banks	9.1
SACCOs	37.8
NGOs	2.2
VSLAs	14.1
Farmer Groups	29.1
Other sources like fellow farmers	16.3

2.1.5 Climate Smart Agriculture Technologies

2.1.5.1 Agro inputs use

The key agro inputs reported are improved seed, fertilizers, pesticide, herbicides and manure. Improved seed is used by majority of the farmers in both schemes for all typologies. Herbicides and pesticides usage are also relatively common in Matanda except under the Coffee/banana typology where the respective usage is 32.4% and 23.5%. However, use of mineral fertilizer is generally low in the scheme (Table 30). As for Matanda, use of improved seed. In addition, although low percentages of farmers use mineral fertilizers and pesticides under the rice and Cereal/Legume dominated fields, close to moderate use these inputs under the coffee dominated fields (Table 30). Similarly, near to moderate percentage of farmers use manure under the rice (36.8%) and Cereal/legume (40.0%) fields. Although most of farmers mentioned to use improved seed, they normally buy it once and recycle it for many seasons - normally as home saved in the subsequent planting, thus its demand is limited and consequently, stoked in low quantities by the agro dealers.

Table: Percentage of farmers using the different agro inputs

Agro Input	Percentage of households reported to be using the different inputs		
	Rice	Cereal/ Legume	Coffee/ Banana
Improved Seed	92.3	74.3	73.5
Mineral Fertilizer	15.4	27.2	17.6
Pesticide	53.8	44.5	32.4
Herbicide	59.0	45.5	23.5
Manure	28.2	23.5	38.2

2.1.5.2 Climate Smart Agriculture Technologies in The Command Area

a. Production and Climate Smart Agriculture Technologies

There are several climate smart agriculture production practices/ technologies applied in the command area. In both schemes under all typologies, most of the farmers use the technologies related to Climate Smart Agriculture as indicated in Table 31.

Table: Percentage of farmers practicing Climate Smart Agriculture

Climate Smart Agriculture Technology	Matanda		
	Rice	Cereals/ legume	Coffee/Banana
Drought tolerant varieties	**66**	**68**	**80**
Early maturing varieties	**91**	**79**	**83**
Use of manure	96	98	75
Mulching	98	93	92
Zero tillage	91	78	80
Safe use and disposal of agro chemicals	84	76	93
Agro forestry	96	73	83

b. Storage and Climate Smart Agriculture Technologies

In the command area, farmers do not use modern technologies adaptable to climate change such as pics bags, cribs and silos for storage of their produce. In contrast, they commonly use ordinary bags. (Table 32).

Table: Storage practices used by the farmers

Storage facility	Rice	Cereals/legume	Coffee/Banana
Ordinary bags	96	91	93.0
Traditional granary	3.0	0.4	0.0
Pics bags	0.0	2.0	0.0
Cribs	3.0	0.4	0.0
Silos	0.0	0.0	0.0
Inside the house on bare floor	20.0	33	20

c. Post-Harvest Handling technologies and Climate Smart Agriculture

Tarpaulins are commonly used across the farm typologies in Matanda. In the former, the percentage usage of tarpaulins is 91.0, 70.0, and 95.0 of the respondents in the Rice, Cereal/Legume and Coffee/Banana dominated fields, respectively. In contrast, shellers and threshers are not popular among across typologies in Matanda irrigation scheme.

Table: Percentage of farmers using the different post-harvest technologies

Technology	Percentage usage		
	Rice	Cereals/legume	Coffee/Banana
Tarpaulin	91.0	70.0	95.0
Thresher	19.0	21.0	15.0
Sheller	14.0	13.0	7.5
Fumigant	40.0	37.0	35.0

2.1.6 Gender and Division of Labor

2.1.6.1 Introduction

Gender roles in production and marketing were investigated for the crops of rice, coffee, tomatoes, maize, beans and groundnuts using Focus Group Discussions (FGDs). The responses from both irrigation schemes were similar and are presented in figs 2, 3, 4, 5, 6 and 7. The results indicate that the marketing potential of

a crop was found as key in determining the gender roles. Males dominate marketing of crops with high market potential i.e., rice and coffee. In contrast, maize, beans and groundnuts which have low value are majorly marketed by the females. Interestingly however, all the activities under the tomato enterprise youth dominated though the majority are males. Although rice and coffee marketing are male dominated, most of the ploughing and weeding are conducted by the females. Nakazi *et al* (2017) also found weeding as one of the major activities that women greatly participate in. Similarly, rice planting, harvesting and threshing activities are mainly carried out by the females. In addition, for the low value crops, all the production activities except site selection in maize cultivation are undertaken by the females. These findings concur with earlier report by Okali (2011), (UBOS 2012) and Ayalew *et al.* (2015) which reported that women in Uganda undertake the majority of agricultural work although they have limited control over production resources, as well as on their own labor and proceeds from sale of outputs. In contrast however, men highly participate in site selection, which could indirectly reveal that they are the land owners who always have to give permission before women can plant. The research further revealed that men offered support in a number of production related activities which required more energy as evidently noted on land clearing. This finding is in agreement with the findings of Nakazi et al (2017) who found men to be typically responsible for the heavier manual tasks such as land preparation.

The low value crops are mainly for household food security. According to McKenna (2014), women put their children and household food security first, and this makes them engage substantially in food crop production but through subsistence farming partly because they lack incentives to increase their production. In contrast, men generally get involved when the food security commodities become market oriented.

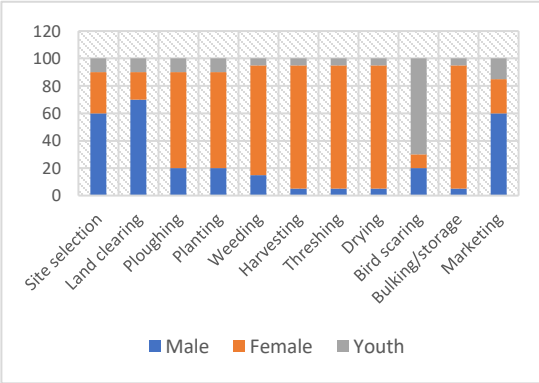


Figure: Gender roles in rice production and marketing

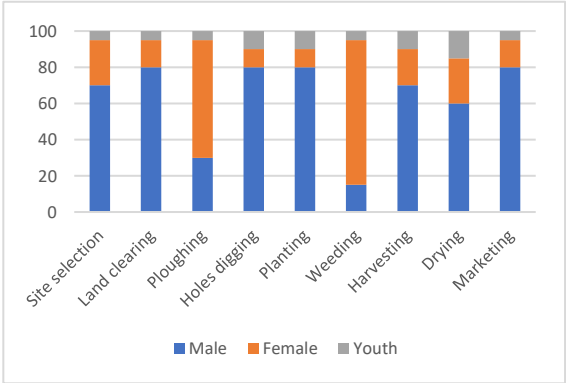


Figure: Gender roles in coffee production and marketing

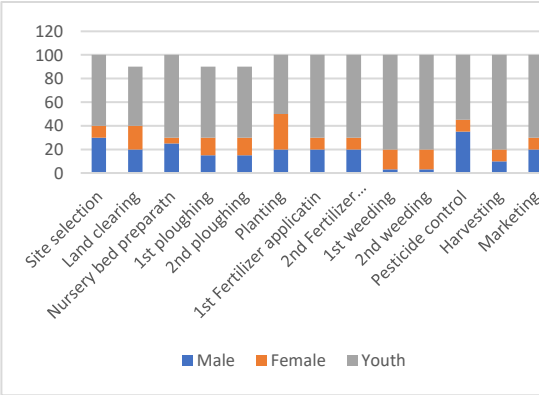


Figure: Gender roles in tomato production and marketing

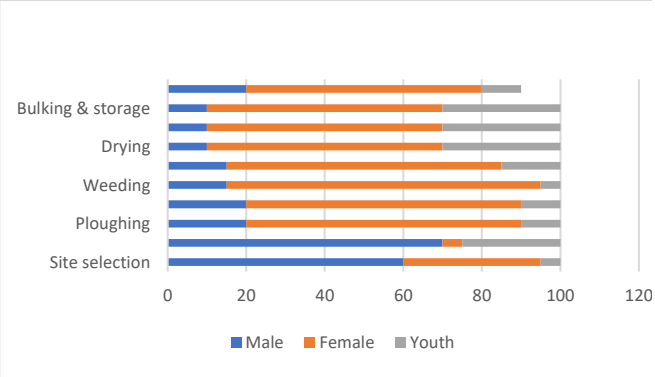


Figure: Gender roles in maize production and marketing

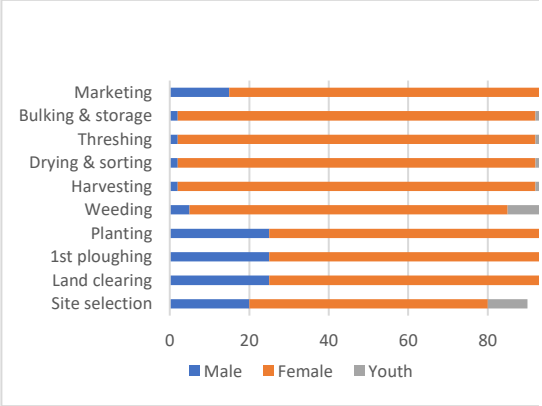


Figure: Gender roles in beans production and marketing

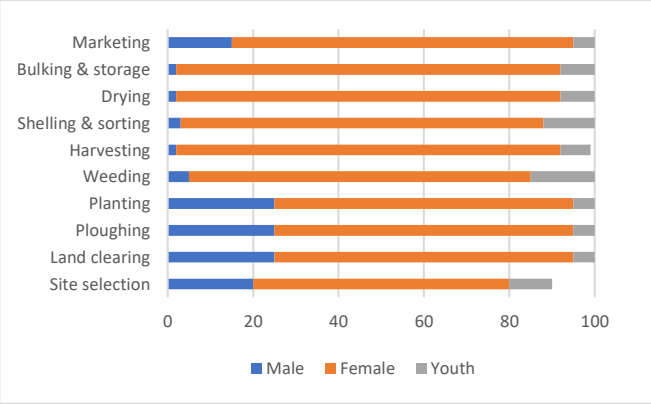


Figure: Gender roles in groundnuts production and marketing

2.1.6.2 Conclusions and Recommendations

Agriculture is a mainstay for the households in the command area. However, yields for all the crops grown are very low compared to the potential. This is attributed to several factors. For instance, the current findings clearly indicated that farmers in the command area rely heavily on rainfed agriculture, which explains why drought is a prominent constraint faced by the farmers to increased and sustainable agriculture production in the project area. It was also revealed that crop pests and diseases are a major constraint. Besides, very few farmers are using productivity enhancing technologies such as improved and quality seed coupled with fertilizers. Worse still, it was noted that a number of recommended Good Agronomic Practices such as second weeding, pests and disease control and following appropriate crop rotation and intercropping pattern are not conducted by a number of farmers. As well, the farmers use rudimentary storage practices that exacerbate post-harvest losses.

The low yields coupled with high production costs in turn affect the net incomes from the crops produced. For instance, using the existing farming practices, the economic analysis showed that farmers' returns are either small or negative for a number of commodities.

Against this background, we recommend the following agronomic practices to increase, sustain and stabilize crop production in the project area:

a. The home saved seed currently being used has low viability, vigour and high pest and disease prevalence. Thus, on a seasonal basis, farmers need to access and use improved high-quality seed. The research organizations and institutes have been releasing high yielding and adapted crop varieties which are drought tolerant but also resistant to pests and diseases.

b. Relatedly, these seeds for improved crop varieties shall be used in combination with other productivity enhancing technologies particularly fertilizers and pesticides but also labor-saving technologies such as herbicides and community tractor services. These inputs shall be accessed from reputable agro input dealers to avoid use of counterfeit chemicals.

c. The farmers shall adopt a full package of Good Agronomic Practices for all crops grown. This includes adoption of practices such as secondary weeding, integrated pests and disease management, among others. In addition, farmers shall follow the recommended sequencing patterns of crop rotations and intercropping during production besides other cultural practices like timely planting and weeding.

d. The farmers need to adopt the use of improved storage technologies such as hermatic bags. Good quality storage is essential as it reduces commodity deterioration in both quantity and quality, while sustaining household food security. Furthermore, it allows owners of stocks to postpone the sale of those stocks until a time during the annual production, harvesting, and merchandising cycle when demand exceeds supply and favorable prices can be realized.

e. There is need to reduce reliance on rainfed agriculture by the farmers. Thus, government and development partners shall support development of suitable irrigation systems by providing a conducive policy environment as well as supportive irrigation infrastructure.

f. Support investments in financing schemes: Low confidence by commercial banks in the sector which increases the level of risk and therefore the cost of finance**.** Financially, farmers do not have access to financial services that would allow them to get the working capital to purchase inputs on credit; and, for the agro-dealers part, the farmers' limited resources often force them to extend long payment terms. Design of programs to link farmers and agro dealers to farmer friendly banks as well as negotiating good friendly interest rates.

g. Support investments in Feeder roads to ease of movement of produce within the districts and within the region, efforts shall be put to sourcing funding for local governments to expand and maintain rural road network in the irrigation areas.

h. Government and development partners shall prioritize enterprises that have a potential for high economic returns like rice, tomatoes, coffee, millet and groundnuts.

i. To enhance adoption of the above, government, development partners and the private sector shall collaborate to strengthen the extension system for the farmers to access the necessary knowledge and skills to ultimately sustain agricultural production in the command area.

2.2 Design and Planning Phase

2.2.1 Project Area

The project area extends from the reservoir area to the command area extention as described below:

i) Scheme Dam located on river Kiruruma in Kanyungutsi and Ibumbye villages at geographical coordinates of (Easting: 0804274.07m, E, Northing: 9910390.48m S), (

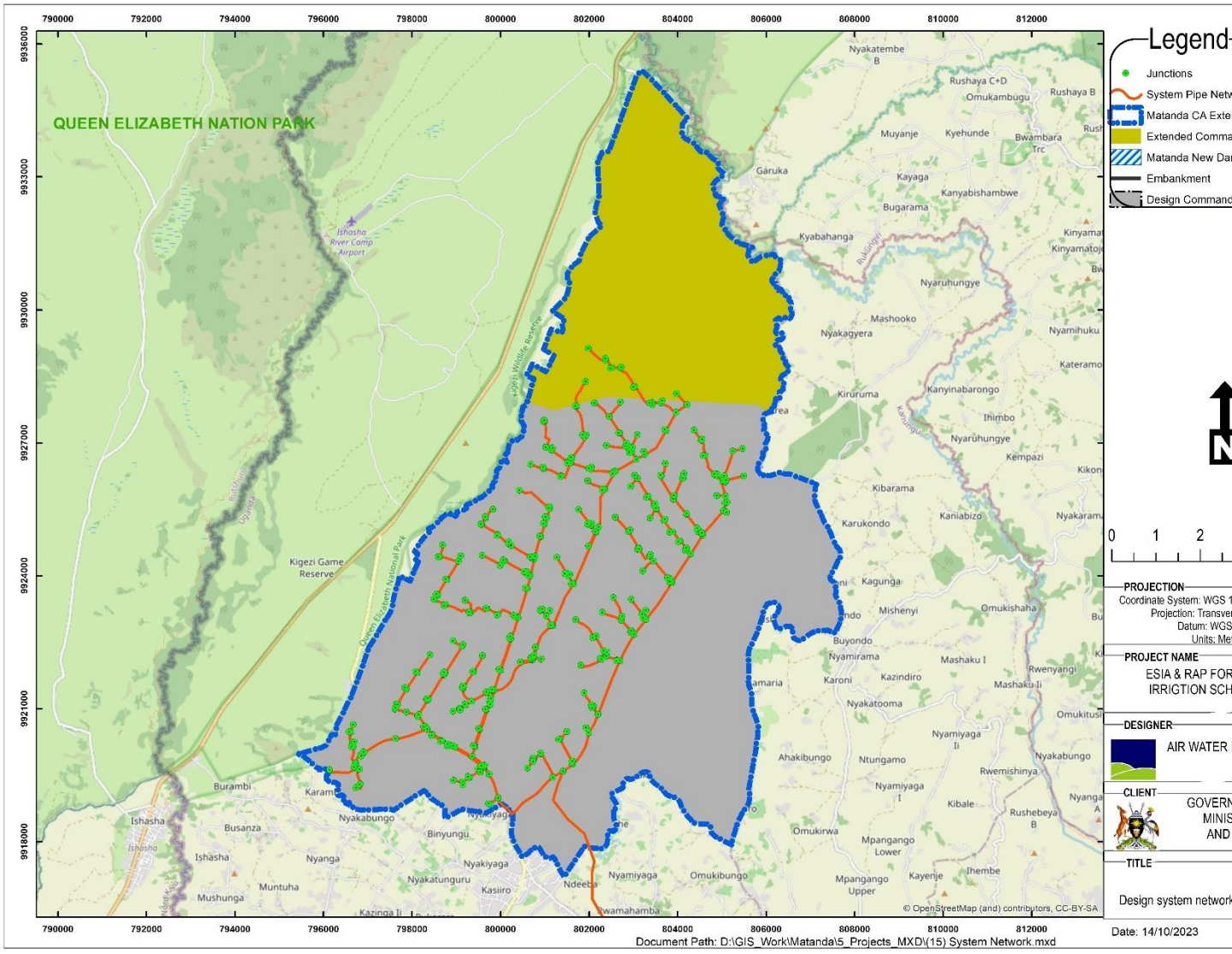


Figure 2-1).

i) Reservoir Area: of 22.7MCM located on river Kiruruma in Mutojo, Ibumbwe, Nyakishojwa, Nyaruhanga, Ibarya, Nyakarambi, Kanyungutsi, and Nyambare villages.

ii) 4420 Ha designed Command area covering; five (5) sub counties: Kihiihi, Kihiihi Tc, Nyakinoni, Nyamirama and Nyanga, 19 parishes, and 55 villages. Whereas the dam is to serve total of 9000 Ha, the pipeline network distribution only covers 4420 Ha under the current design.

iii) 9000 Ha Command area extent covering; five (5) sub counties; Kihiihi, Kihiihi Tc, Nyakinoni, Nyamirama and Nyanga, 19 parishes, and 124 villages. (Appendix B).

Cited location project design was hinged on community-based participation with the districts and sub counties as focus of implementation, and the private sector as main technical service providers. The focus therefore was to develop the identified sites into modern irrigation schemes with farmer based sustainable institutional management arrangements.

As shown in Figure 2-1A, the estimated distance between the Park boundary and the pipe network is 150 meters.

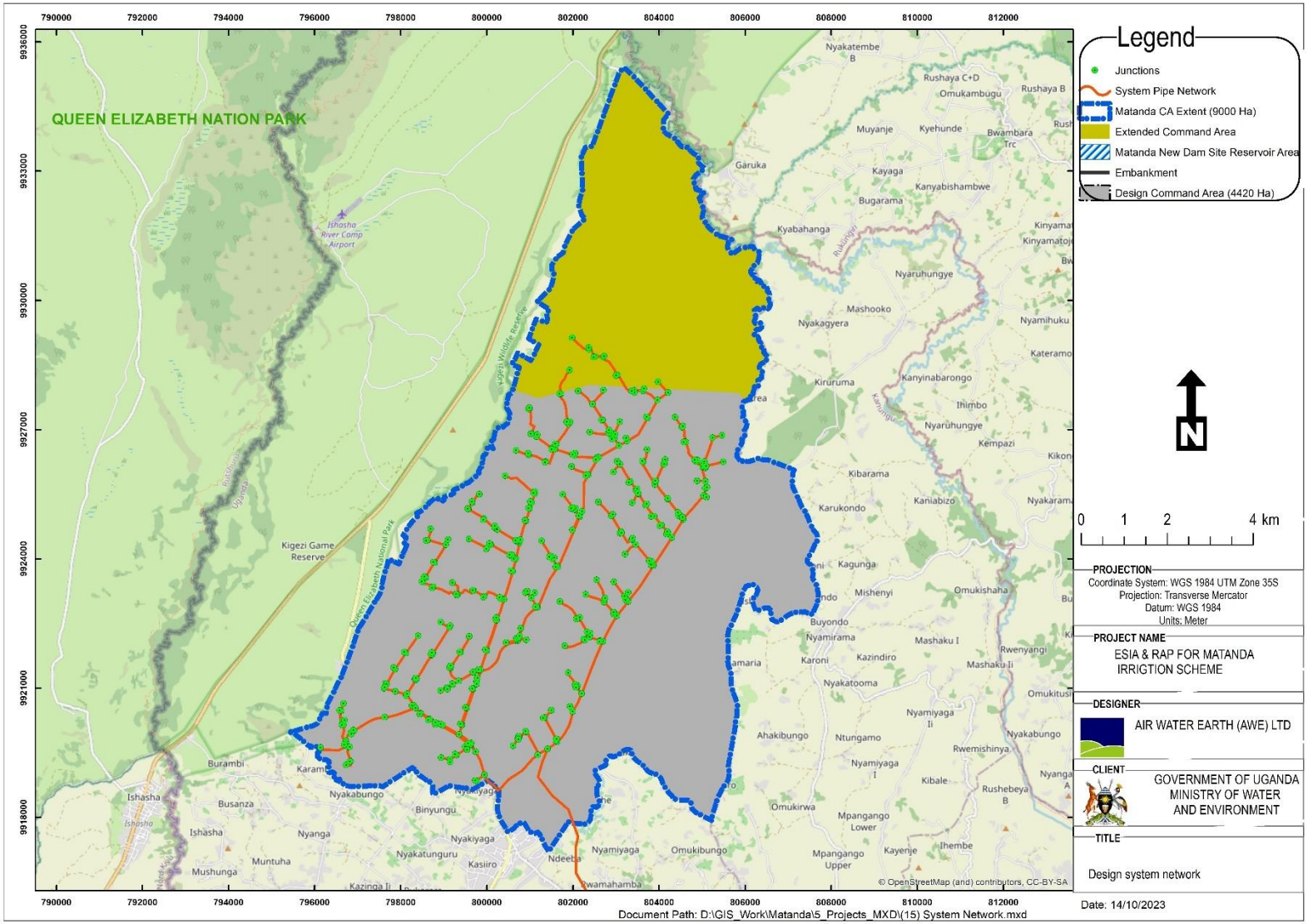


Figure 2-1A: Location of the Matanda Irrigation network

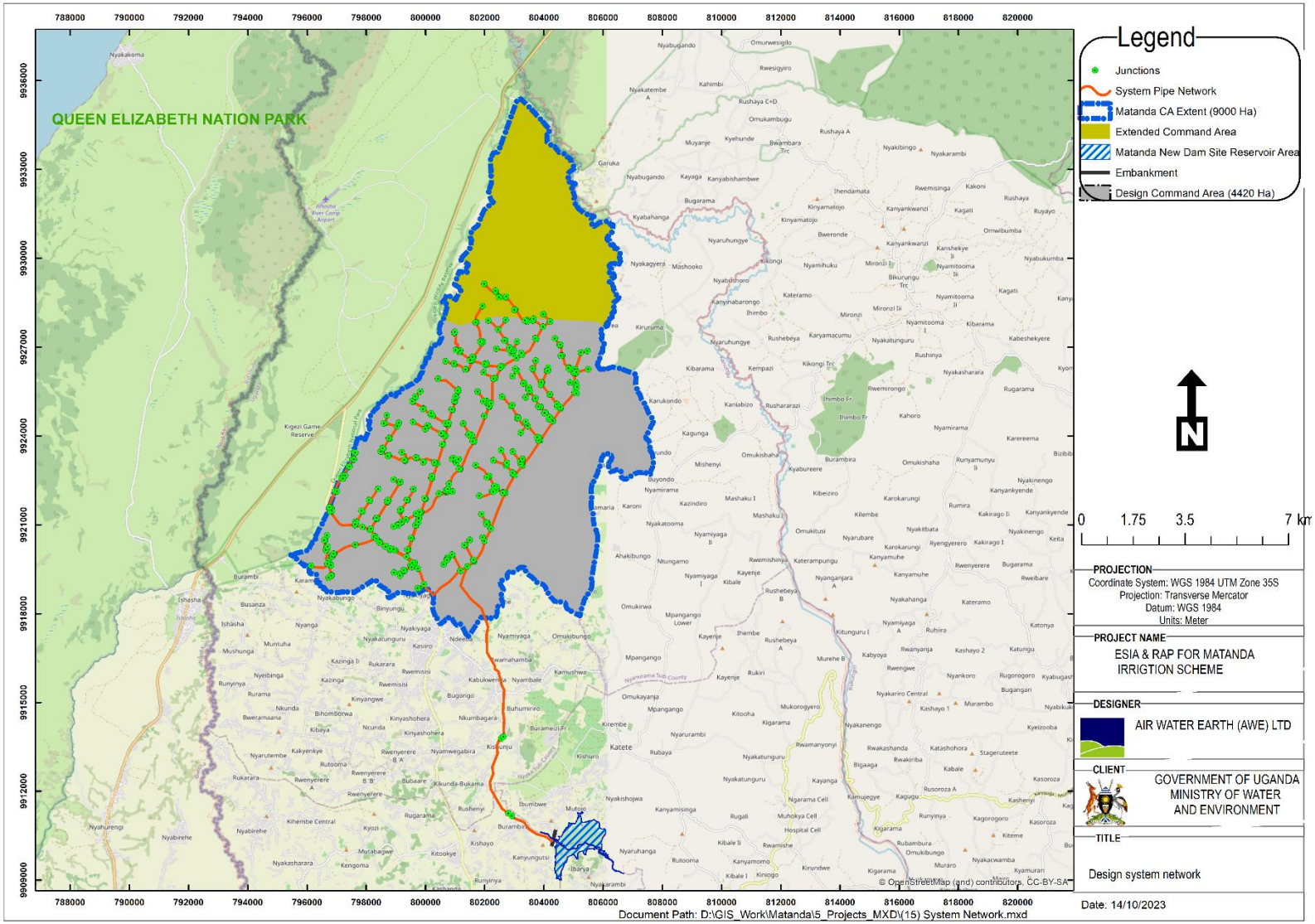


Figure 2-2B: Location of the Matanda New Dam Site Reservoir area

2.2.2 Project components

The proposed scheme design has catered for mainly 2 components including a dam and its auxiliary works, and an irrigation network and associated structures.

2.2.2.1 Matanda Scheme Dam

A. Catchment Area Characteristics

The catchment area up to the dam site is 137.9 sq.km. The Gauge and Discharge (G&D) site (84270) at Katete-Kahili road is downstream of the dam site. The drainage area up to the G&D site is 162 sq.km. Thus, the flows at the dam sites are deduced on catchment area pro rata basis from the observed flow data at the respective stream gauging sites. Actual rainfall data of the drainage area is not available as there are no rainfall stations established in the proper catchment area. The drainage area is in the southwestern part of Uganda and occupied by rock formations belonging to the Paleoproterozoic era.

Table 2-1 : Matanda Scheme catchment area characteristics

Parameter	Upper site
Drainage area up to the dam site (km^2)	137.9
Drainage area up to the G&D site (km^2)	162
Mean discharge at the gauge (m^3/s)	1.84
Annual Flow at gauge Discharge (m^3/s)	58.16
Average Annual Flow at Dam (m^3/s)	54.12
Mean discharge at the dam site (m^3/s)	1.84
Catchment slope	27.4
Stream length	34.7

B. Diversion Works

Matanda dam shall be built in river watercourses, therefore interferences from river flow are the main risk source during the construction process. To free the dam foundation from river water, river diversion during dam construction shall be undertaken.

A river-cutoff cofferdam of 5 metres high with a 10 year return period having a discharge of 18.0m3/s shall be constructed as a roller compacted concrete which will also serve as a trial embarkment for the main dam, and a diversion pipe of 138 meters long with pipe diameter of 2.0 meters with a discharge of 14.7m3/s shall be installed.

The land area to be covered by the dam, reservoir, and diversion structures (coffer dam and pipe) is going to be compensated and acquired by the Government. The RAP preparation and reviews are ongoing.

C. Dam Geometric Design

The proposed dam site (Table 2-2 and

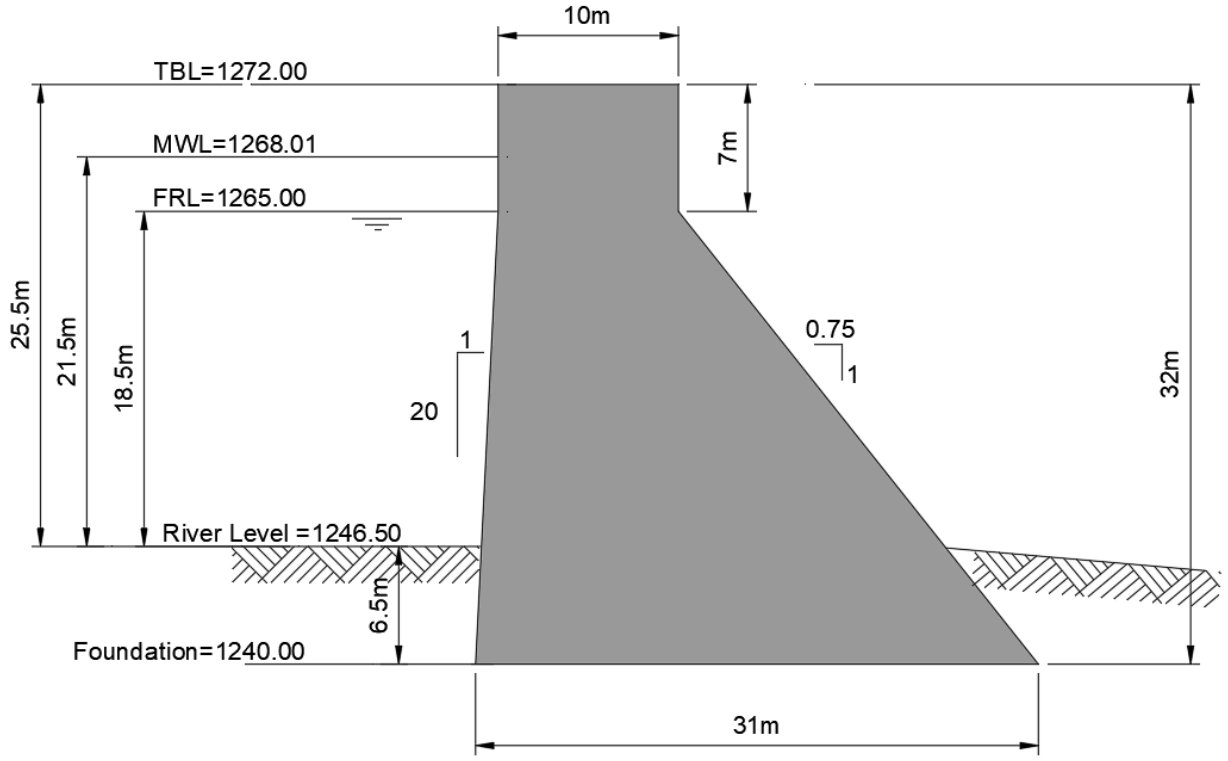


Figure 2-3) is a Roller Compacted Concrete (RCC) structure with a 0.5m thick concrete jacket. The maximum dam height is expected to be approximately 32m with crest length of approximately 163m based on an +1272m crest elevation.

Table 2-2 Matanda Scheme Dam Main Features

	Dam Parameter	Value
1	Type of dam	Roller Compacted Concrete (RCC) with 0.5m thick C25 concrete Jacket
2	Total Height of the Dam	32.00m
3	Base width of dam	31.13m
4	Crest Length of the Dam	163.00m
5	Dam crest thickness	10.00m
6	Bund Parapet Wall	1.50m
7	Top Bund Level (TBL)	1272.00m
8	Maximum Water Level (MWL)	1268.01m
9	Full Reservoir Level (FRL)	1265.00m
10	Top Bund Level	1272.00m

	Dam Parameter	Value
11	Freeboard	4.00m
12	Upstream slope of dam	0.05: 1
13	Upstream slope of dam	0.75: 1
14	Foundation Level	1240.00m

Table 2-3 Other dam appurtenances

Feature	Elevation
River sluice 1.2m×1.2m	+1246.84m
Construction Sluice 1.2m×1.2m	1252.00
Irrigation Outlet	1252.0
Spillway Width	35m
Spillway Bridge Length	35m
Height of Spillway Training Walls above the Channel Bed	8m

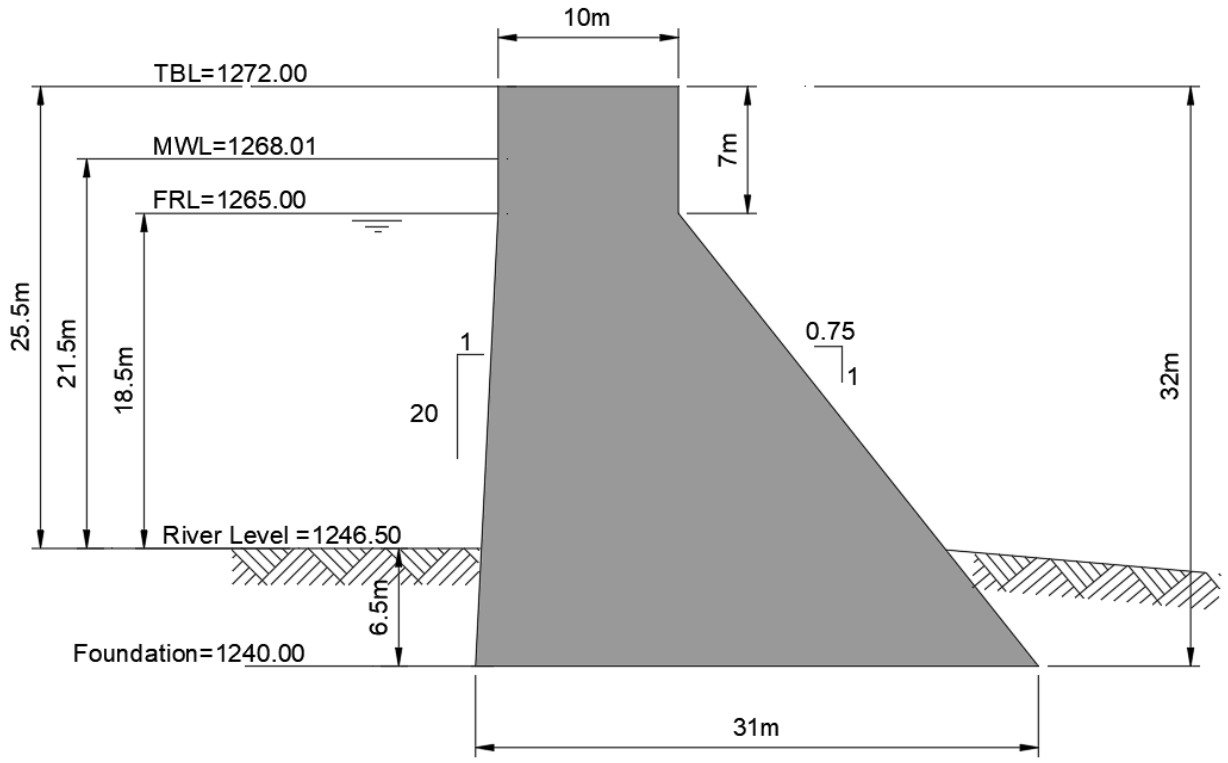


Figure 2-3 Dam cross-section dimensions

D. Reservoir

The reservoir straddles villages of Mutojo, Ibumbwe, Nyakishojwa, Nyaruhanga, Ibarya, Nyakarambi, Kanyungutsi, and Nyambare from the proposed dam site (at geographical coordinates of: Easting: 0802766 mE, Southing: 9931749 mS). The useful life of the reservoir is considered as 50 years. Matanda reservoir is classified as Type II (Flood plain & Foothills).

Table 2-4 Reservoir Main Features

Parameter		
	Level (m)	Volume (m3)
Minimum levels	1246.5	42
Dead storage	1252.6	2,217,399
Minimum operating level	1254	3,746,329
Maximum Reservoir Storage Level FRL	1265	22,723,883
Flood levels-T=10,000 years	1267.69	28,826350
Flood level-PMF	1268.01	29, 592,040
Danger flood (2.5 x PMF)	1270.51	35,907,184

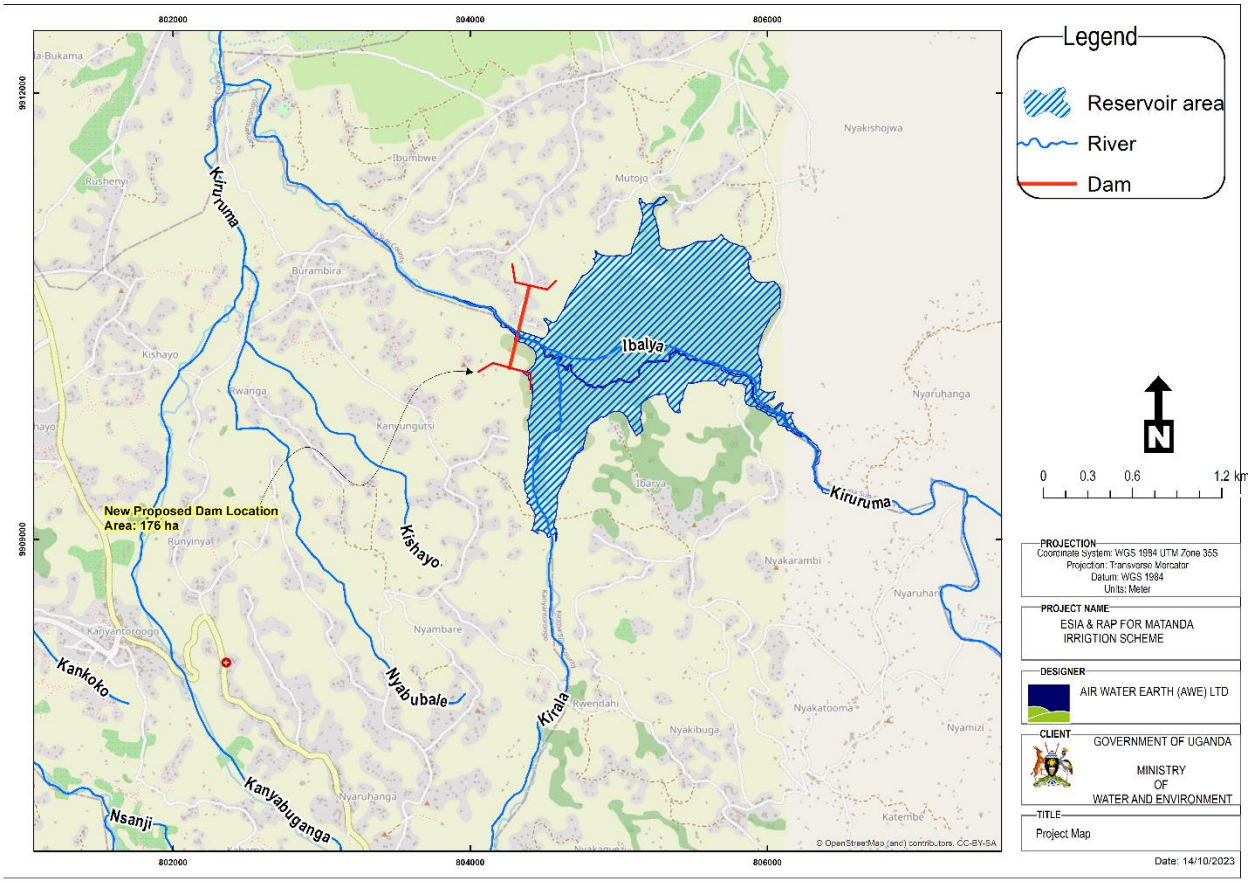


Figure 2-4*: General overview of Reservoir*

The reservoir routing simulations were carried out based on comparisons of the water inflows to the reservoir and total potential demands (irrigation, water supply & livestock) in order to simulate the reservoir operating levels and thus rate of success & deficit, if any. These were used as an input for the reservoir regulation, simulations aimed at estimating the reservoir operation for the water resource allocation.
Following are the requirement of inputs for simulation studies.

- Water inflows to the reservoir: The yearly inflow is varying from 32.92 MCM (in 1973) to 106.22 MCM (in 1987) and average rainfall is 54.12 MCM.
- Total Water Demands (considered for simulation in various scenarios; Irrigation water requirement for proposed extent of command area and Environmental releases as proposed in each scenario)
- Lake evaporation
- Area – Capacity table

E. Summary of Proposed Instruments

Table 2-5 summary of the proposed instruments

S/N	Name of Instrument	Purpose	Location	Quantity (No.)
1	Staff Gauge	Measure level of water in reservoir and tail water	At upstream & at the Downstream of Reservoir	02
2	Base-Strain-Gauge-Temperature-Meter	Strain and temperature measurement in the dam body	In Dam body	72
3	Casagrande piezometers	Pore water pressure	At dam foundations	05
4	V-Notch Weir	Flow from the dam drainage pipes	At drainage pipe exits & instrumentation gallery	03
5	Radar Level Meter	Dam Levels/displacement	At left flank of the dam	01
6	Benchmark Pillar	Dam Levels/displacement	On the dam & at the downstream end	04
7	Target (Levels)	Dam Levels/displacement	At top of the dam	06
8	Strong Motion Accelerograph	Seismic response	At the top of the dam	01
9	Modern weather station	General weather data	Near to dam location	01

F. Dam safety

Proposed Matanda Reservoirs constitute a potential hazard to downstream life and property. Catastrophic failure of a dam, other than as the direct result of an extreme flood event, is invariably preceded by a period of progressively increasing 'structural' distress within the dam and/or its foundation.

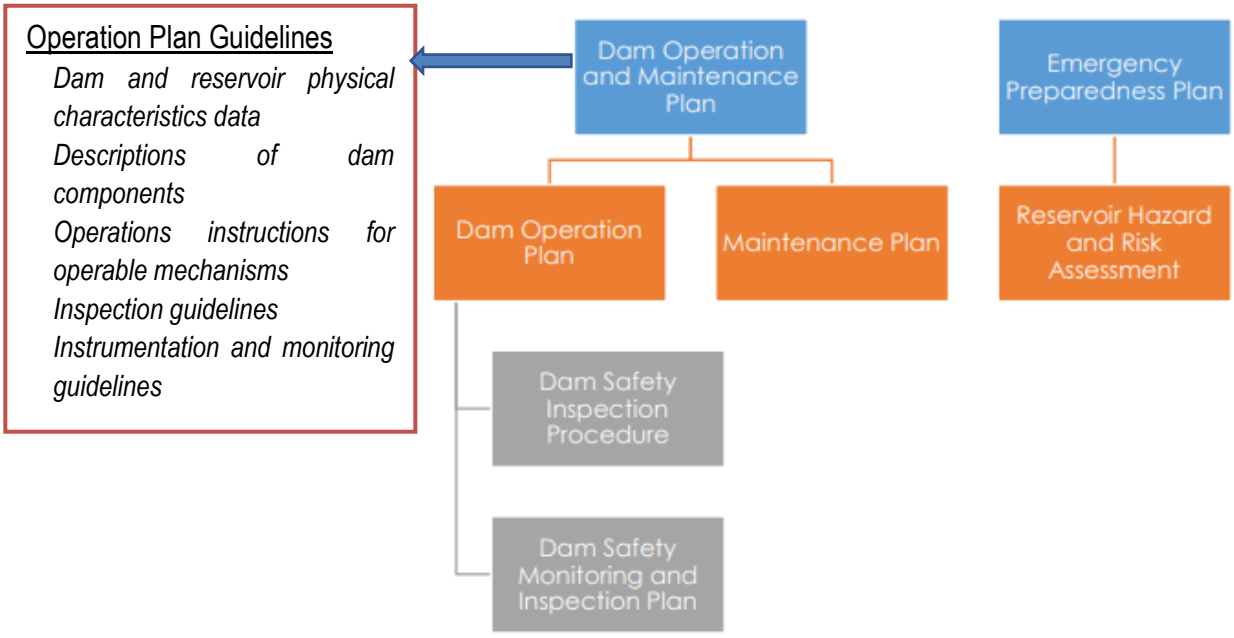
The hazard potential for the proposed dam is related to its location upstream of Kihihi Town. The current hazard potential is low because the town is far from the river course and is at higher elevation compared to the river valley and the seismic harzard is classified as low with return period of 50 years.

Much as the proposed site lies within zone 1 of the seismic zoning of Uganda, implying that there's a high risk of earthquake occurrence at the site, the seismic risk with a return period of 50 years is classified as Low.

Whereas the seismic risk is low with a return period of 50 years, the design of the dam considered Maximum Design Earthquake (Peak Ground Acceleration of 0.15g).

The following dam safety plans have been prepared by the design consultants and approved by the Dam Safety Panel of Experts:

- Construction Supervision and Quality Assurance Plan (CSQAP)
- Instrumentation Plan (IP)
- Operation and Maintenance Plan (O&MP), and
- Emergency Preparedness Plan (EEP).



The dam management unit is composed of the following actors:

- Dam Manager

- Technical Department
- Dam Safety Engineer

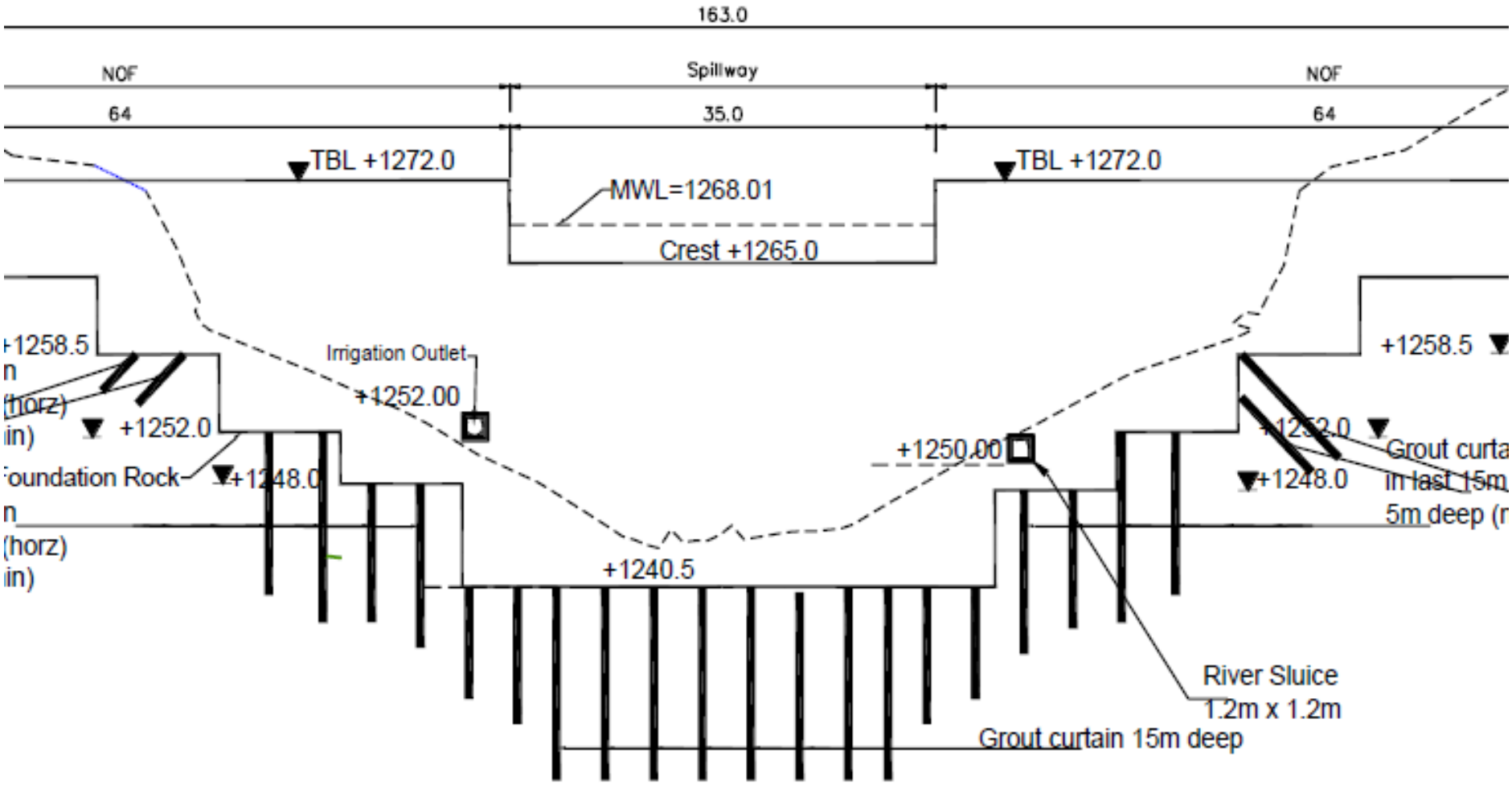


Figure 2-5: Plan Layout for Matanda Dam (NTS) *(Source: Matanda Irrigation Scheme Design Report)*

2.2.2.2 Irrigation Network Design

A. Cropping Pattern

The main objective of the proposed cropping pattern is to sustain both subsistence and market-oriented agriculture, as such; it includes a balanced mix of food, cash and feed crops. Based on the existing cropping pattern, soil suitability and balanced mix of food and cash crops, the cropping pattern was proposed for determination of irrigation water requirement and thus to develop different scenarios based on simulation studies.

The irrigation water requirement was determined with 200% cropping intensity as 3415 m^3/hectare for the proposed cropping pattern. Coffee/Banana keeps a line share (35%) given its double role of staple and cash crop. Groundnut (5%) Beans (5%), Maize (5%), Rice (10), Vegetables (30%) and Fruits (5%). In addition to the above crops, Fodder grass (5%) is proposed. Table 2-6 below shows the list of crops and their relative presence in the cropping system.

Table 2-6 **:** Proposed cropping pattern

Crop	SEASON I & II
	Area (Ha)
Rice	965.2
Groundnut	482.6
Coffee/ Banana	3378.3
Maize	482.6
Beans	482.6
Cabbage	723.9
Carrot	72.4
Tomato	723.2
Onion/ Green Pepper	723.9
Watermelon	482.6
Fodder	482.6
Total	**9,000**

Crop Calendar

The following figures represent the percentage of crop areas and timing of crop cycles for the total foreseen irrigated area of 9,000 ha.

Name of Crop	Area (Ha)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice	442												
Groundnut	221												
Coffee	1547												
Maize	221												
Beans	221												
Cabbage	331.5												
Carrot	331.5												
Tomato	331.5												
Onion/Green pepper	331.5												
Water Melon	221												
Fodder	221												

B. Design command area irrigation method

Matanda irrigation scheme covers a total irrigation command area of 9,000ha, undulating with rolling terrain topography having 0 to >12% slopes in multi direction and is to be served with a gravity dam of 22.7 Milion cubic metres. The irrigation command area develpment is proposed to be implemented in three phases of 2,200ha (phase 1), 2,220ha (phase 2), and 4,850ha (phase 3). A closed pipeline network distribution contemplated with pressurized irrigation systems (Drip/Sprinkler/Flexible hose pipe) will be adopted to water all the cropped fields.

(i). **Sprinkler Irrigation System**: In a sprinkler irrigation system water is moved dynamically from the water source through a sprinkler nozzle to a desired height at a high velocity where it breaks up into small droplets in the air and falls on to the soil or crop surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. Sprinkler pipelines are light in weight, hence can be easily transported and installed in the field. They are highly flexible, crack and impact-proof, sustain high pressure and temperature, hence more durable. Due to sprinkling action water wastage is less.

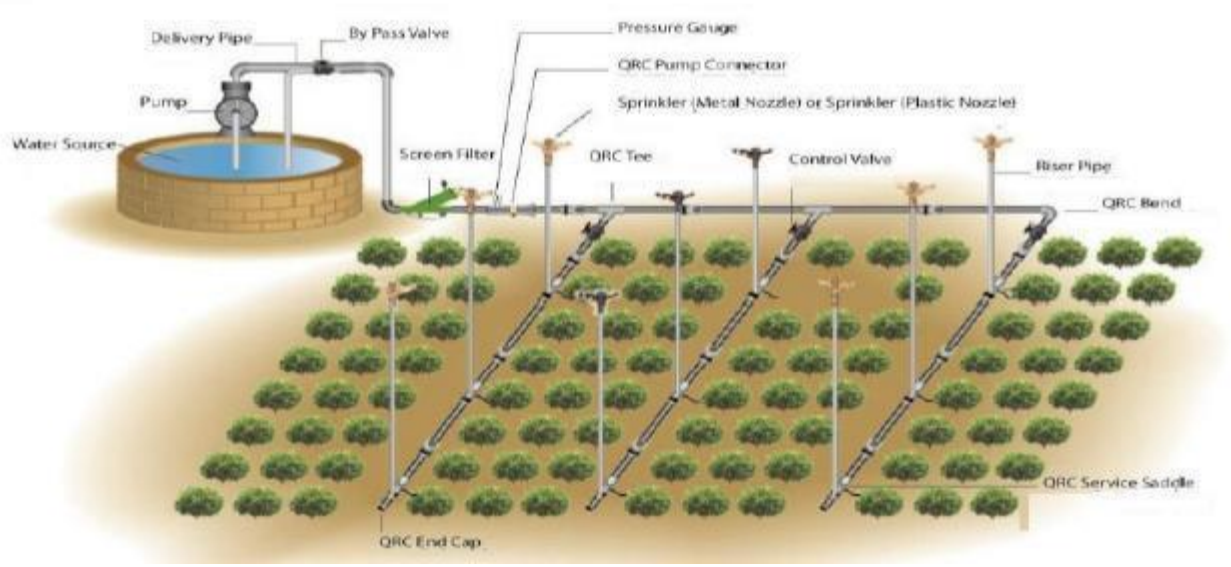


Figure 2-6: Layout of Sprinkler Irrigation System

Table 2-7 : Minimum Head Required at Sprinkler Lateral Pipe

Sprinkler Nozzle Design Discharge =	0.000511111	m^3/s
Sprinkler Nozzle Design Head =	35	m
Drag Hose Pipe Length =	36	m
Sprinkler Tripod Height =	1.1	m
Lateral Pipe Cover =	0.6	m
Drag Hose Pipe Nominal Diameter =	25	mm
Drag Hose Pipe Inside Diameter =	22.06	mm
Flow Velocity =	1.34	m/s
Flow Velocity Head =	0.09	m
Elbow K =	1.13	
Minor Head Loss =	0.21	m
Friction Head Loss =	3.73	m
Total Head Loss =	3.94	m
Required Head at Sprinkler Lateral Outlet =	**40.64**	m

Table 2-8 : Required number of Sprinkler for Matanda Sprinkler Lateral Pipes

Lateral Length	Average Irrigation Area (ha)	Required No. of Sprinkler Sets	Design Discharge of the Later (L/s)	Number of Days Required to Irrigate the Lateral
27m to 99m	0.6	1	0.511	5 to 15 days
117m to 225m	1.6	2	1.022	9 to 16 days
243m to 351m	2.8	3	1.533	12 to 17 days
369m to 477m	3.9	4	2.044	13 to 17 days
495m to 603m	5.0	5	2.556	14 to 17 days

(ii). **Drip Irrigation System**: Drip Irrigation is a method of Irrigation with high frequency application of water in and around the Root Zone of the plants rather than the entire land surface. The system comprises of a network of pipes along with suitable emitting devices, supplying water directly to the plant root zones at frequent intervals in controlled quantities as per the requirement of the plant, through filtration system and a low-pressure network of piping including Main, Sub Main and Lateral Lines with emitters or drippers spaced along the lateral lines. It allows application of small quantities of water, which ultimately provides a constant soil water condition at the Root Zone area, ensuring that the plants never undergo

water or nutrient stress, thus enabling the plants to achieve optimum growth and high yield with better quality.

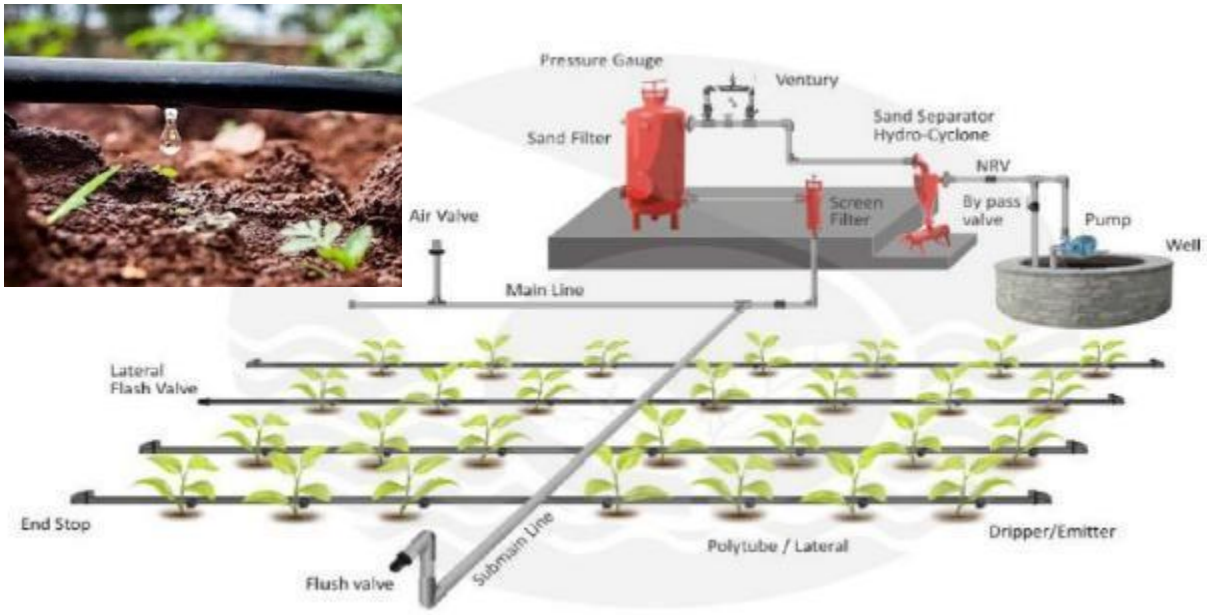


Figure 2-7: Layout of Drip Irrigation System

(iii). Flexible Hose Irrigation System

Where the pressure head available is less than 15 m, the pressurized irrigation i.e., sprinklers and drip methods are not suitable and hence, the flexible hose irrigation is suitable. This method of irrigation, water is applied to the basins and the furrows through ¾ - 1 ½ inch plastic hose which area portable, hand move, and can be extended in various directions. When one furrow or basin has been filled up with water, the hose is moved manually to the next one and so on.

The entire design command area was delineated into 20 ha blocks (Figure 2-12) with 0.6 lps/ha water discharge at each block having a hydrant with pressure regulating valve and flow control valve. It will be extended up to farms with a hydrant and flow meter at individual farms with an on and off valve. Based on the pressure head available as presented in pressure Zone map and enclosed as Figure 2-13, the extent of area suitability in each Irrigation method is given in Table 2-2: However, in few of the blocks, all the three/two pressure zone categories via; <15m, 15-25m and >25m pressure heads available. In such blocks the pressure zone wise area is subdivided, and separate pipelines were laid to each pressure zone sub block with pressure control valve. Thus, varied pressures regulated to single pressure zones enabled uniform method irrigation in the entire block. Based on the pressure head available in the pipeline network, about 53% of the command area has pressure head > 25m as shown in the table above. Among the crops proposed only 35% of the command area can be irrigated by sprinkler irrigation method. Hence higher pressures need to be controlled by using pressure control valves and adoption of Drip/Flexible Hose system is necessary wherever needed. In view of above the suitability of drip irrigation to the proposed crops is about 40.20%, flexible hose/portable pipes 24.8% and only 35% of the cropped area is suitable for irrigation with sprinkler as shown in the Table 2-10.

Table 2-9 : Extent of area under each method based on the pressure head

S.No	Pressure Range	Type of Irrigation	Area (Ha)	%
1	<15m	Flexible Hose	1098	24.8
2	15 – 25m	Drip	971	22
3	>25m	Sprinkler	2351	53.2

Table 2-10 : Crops proposed under each method of irrigation

S.No	Type of Irrigation	Suitable Crops	Area (Ha)	%
1	Flexible Hose	Coffee/Banana, Beans, Maize	1098	24.8
2	Drip	Coffee/Banana, Beans, Maize, Tomato, Cabbage & Water Melon	1775	40.2
3	Sprinkler	Rice, Groundnut, Fodder, Carrot & Onion	1547	35

C. Irrigation system design

Matanda irrigation system comprises of; primary, secondary and tertiary distribution lines reaching the different zones in the command area up to block hydrant (20 ha). The *main distribution/primary line* will convey the flow of the system under optimized hydraulic conditions of flow velocity and friction losses from the source to the sub-main (secondary) distribution lines. The *secondary distribution lines* will extend from the main lines to reach significant irrigation areas lying far away from the main pipeline, branching into *tertiary lines* to serve the single irrigation unit. The pipe network is proposed to run along the existing roads with the shortest distance possible. While preparing the network, an isolated pipeline (secondary or tertiary) is provided to have better regulation and collection of water charges. The pipe network plan up to 20ha enclosed below (Figure 2-14) illustrates the location of the pipelines and hydrants, and indicates the name associated with the main distribution lines.

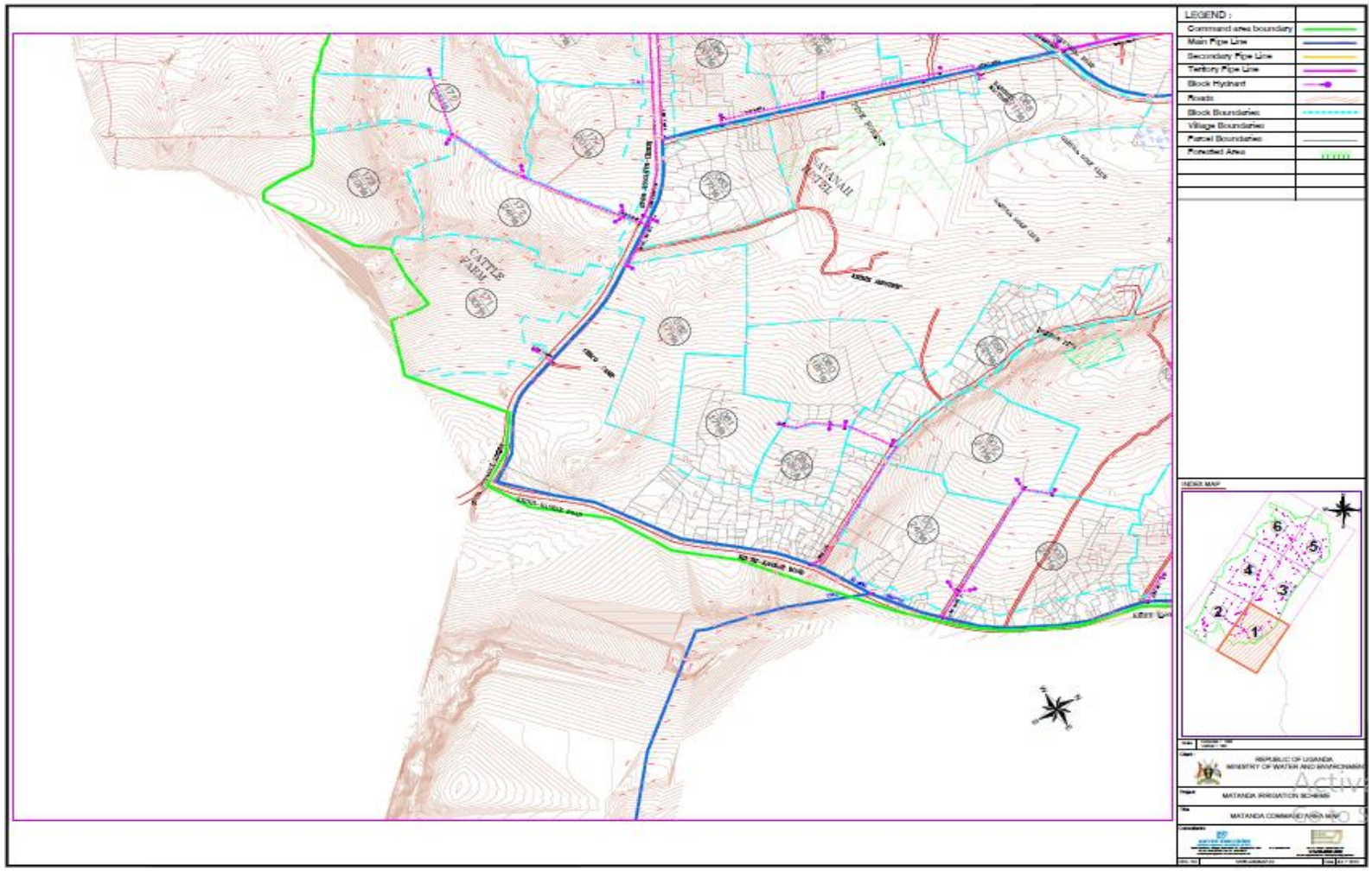


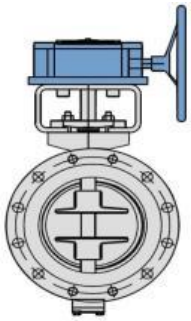
Figure 2-14: Irrigation Pipe Network up to an average of 20Ha per Block (*Source Scheme design report)*

D. Pipe material adopted in Matanda irrigation scheme

For pipes having diameter more than 1000 mm, Steel Pipe (MS Pipe) with epoxy lining and outer cement gunite are proposed duly optimizing economy, strength and usage. For ranging from 300 mm to 1000 mm diameters, Ductile Iron (D.I) pipes with cement mortal lining and outer coating with zinc are proposed since MS Pipes are costlier. The pipes having diameters less than 300 mm, HDPE pipes are proposed.

E. Valves adopted in Matanda irrigation scheme

Butterfly Valves



13 butterfly valves ((2)1450 mm, (1) 900 mm, (2) 800 mm, (1) 700 mm, (2) 600 mm, (2) 500 mm, (3) 300 mm diameter) will be provided at an interval of about 5 Km or wherever required conforming to BS EN 593 with pressure rating of PN 6 to 20. They will be used to stop, regulate, and start the flow.

- Double flanged type valve with bypass arrangement is proposed for MS pipes with a butterfly valve size 80% main pipe diameter for the MS pipelines.
- For DI pipes, the valve size is considered as equivalent to pipe diameter to reduce the losses and to avoid connection problems. Double flanged valve with a short body is proposed for DI pipes from 700mm to 900mm diameter and wafer type valve is proposed from 300 mm to 600 mm diameter.

Scour/Gate Valves

52 Scour/Gate valves (7) 900 mm, (2) 800 mm, (2) 700 mm, (8) 600 mm, (15) 500 mm, (8) 300 mm, (10) 0 mm diameter) are provided on pipelines to drain out the silt accumulated in the pipeline and to empty the pipeline whenever required. The Scour valves are provided at suitable locations depending upon site conditions at lowest points such that portions of the pipe between valves can be drained. Scour valves will drain into the natural stream. The size of the scour valve is proposed as 1/4 to 1/5 of pipe dia. Gate valves shall conform to BS 1952/3464 with pressure rating of PN 6 to 20.

Air Valves

99 air valves ((14) 300 mm, (4) 250 mm, (3) 200 mm, (14) 150 mm, (29) 100 mm, (16) 80 mm, (19) 50 mm diameter) are provided to exhaust air from pipe automatically when pressure rises in pipe and supply air to pipe when pressure drops in pipe to avoid damage of pipe. Air shall be released at a sufficiently higher rate so that there shall be no restriction for the inflow rate. Similarly, the valves shall be capable of ventilating the pipeline automatically when being emptied. The air inflow rate shall be sufficiently high to avoid development of vacuum in the pipeline. Air valves are proposed at apex points of the gravity pipeline. Air valve size is 1/4th to 1/5th of pipe diameter and is proposed on the stem pipe of diameter equivalent to size of air valve with Isolation valve. The air valves shall conform to BS EN 1074-4 with pressure rating of PN 6 to 20.

Pressure and Flow Control Valves	A Pressure Control Valve (Pressure Reducing Valve) will throttle flow and maintain downstream pressure at the required level, but only if the upstream pressure is higher than the pre-set level. Flow Control Valves are either direct acting or pilot operated. Pressure and Flow Control Valves are proposed at 20Ha Block to ensure a constant operating pressure & flow for the laterals.
Water Meters 	Water meters measure and record the volume of water passing through them, without considering the time element. Reading the output of a water meter gives information about the volume of water that passed through the appliance in a period, beginning with the last reading or zeroing of the meter. The most common type used for irrigation water is the Woltmann type with an impeller for axial flow. Water Meters are proposed at every 1Ha.
Ball Valves	Ball valves are designed for direct operation by a hand wheel or wrench. Manually operated valves shall close by turning the hand-wheel or wrench in a clockwise direction when facing the end of the operating shaft. Hand wheels shall be marked 'Close' or 'Shut' with an arrow to indicate the direction of closure. Ball Valves are proposed at each farm as ON & OFF valves.

2.3 Pre-Construction Activities

Activities to be undertaken during the pre-Construction phase of the project will basically include;

Table 2-11 : Activities to be undertaken during the pre-Construction phase

Mobilization of Project Team	The contractor will notify, gather and deploy all team members / work force to the proposed site, ready for the assignment. During the Construction Phase, the Project will employ approximately 300 employees including; unskilled, semiskilled and skilled.
Development of plans and obtaining of required permits	The contractor will draft cited plans in Section 3.8 (Table 3- 4), submit to the client for approval and also acquire project required permits in section 3.7 (Table 3- 3) from the relevant issuing authorities.
Land surveys	The entire design command area of 9000 ha of Matanda irrigation scheme, constituting of the 20 ha blocks and the primary, secondary and tertiary distribution lines reaching the different zones in the command area will be surveyed. Topographic measurements with leveling will be conducted with the help of GIS instruments and National control points in Kanungu District.
Land acquisition	Based on the Resettlement Action Plan (RAP) report for the scheme, all required land will be affected. MWE has developed a livelihood restoration plan as part of the RAP to cater for impacts of economic displacement, access roads, and clearing of trees and crops, among others.
Acquisition and Transportation of construction material and	The contractor will deploy all necessary logistics and equipment, including; *Raw construction materials*; sand, cement, building stone blocks, gravel, Personal Protective Equipment (PPE), coarse and fine concrete aggregates, paints, solvents, reinforcing steel, Pipes and Valves (Steel Pipe, Ductile Iron pipes, HDPE pipes, Butterfly

equipment to the project sites	Valves, Scour/Gate Valves, Air Valves, Pressure and Flow Control Valve, Water Meters, Ball Valves). *Equipment*; Survey equipment, Wheeled excavator, Track Loader, Dump Truck, Bulldozer, Backhoe loader, Water tankers, Concrete mixer, Generators, Signage, and reflective vests, protective clothing (gum boots, overalls) printed inspection forms, drawings, field instruction books and many others are well in place for the team to commence works. The relevant due diligence must be undertaken during acquisition or procurement of construction materials (preferably from licensed dealers), including undertaking relevant environmental and social assessments for the determined quarry and borrow sites by the awarded contractor in consultation with the local authority. Water abstracted from River Kiruruma for construction shall be sought for a surface water abstraction permit from DWRM.
Site clearance	Vegetation clearing and removal of top-soil and subsoil by mechanical stripping and stockpile at designated locations.
Construction of access roads or improvement of existing roads	The road to the dam site location will be enlarged and stabilized in order to transport heavy construction materials and machineries. Also, the contractor's camp site access arrangements will need to be capable of carrying all envisaged construction traffic including transport of construction materials and equipment to the site, together with normal construction traffic around the site.
Auxiliary facilities	Other auxiliary facilities, including temporary contractor's construction camp, equipment yard will be subjected to screening using the WB Environmental and Social checklist and further subjected to site specific ESIAs before construction/operations. Upon screening the sites, further processes of preparation of ToRs and scoping reports and undertaking the ESIA study will follow. These will be reviewed by the World Bank and approved by NEMA.The awarded contractor in consultation with the local authority will undertake construction upon seeking approval from MLHUD and after meeting the necessary NEMA requirements, which include payments to the owners, among others. The camp is envisioned to provide space for; project office (Contractor, the Engineer, Environment and Social SafeGuards Specialists and the Employer), project fleet parking, equipment yard, material storage yard, accommodation units, and health unit.

2.4 Construction material

Probable construction materials required for the dam including the respective quantities based on the dam design, potential sources were identified through the geotechnical investigations survey in vicinity of the dam.

The investigations included identification of;

- Borrow Areas: Sources of natural materials for the cofferdam construction and the associated infrastructure such as service roads and drainage structures.
- Quarry Sites: Sources of hard rock for pitching, rock fill and aggregates for concrete works for the dam and the associated project infrastructures.
- Sand sources for the construction works.

❖ Water sources for construction.

Table 2-12 gives a summary of the material description, location, and estimated volume. The identified sources are within economic distances from the proposed dam sites. The perpendicular distance shown is applicable to Kabukwenda site.

Table 2-12: Location of the different Construction materials

Material	Material Description	Location	Perpendicular distance from the Dam (km)	Size of the Clay source (m)	Estimated Volume (m3)
Clay	Dry firm grayish brown lean clay	Kiruruma Cell, Kanungu district	1	300 x 200	240,000
Sand	Slightly moist loose yellowish brown coarse Silty SAND.	Kiruruma Cell, Kanungu district	5.4	100 x 200	400,000
	Slightly moist loose yellowish brown coarse Silty SAND.	Buhumurilo cell, Kanungu district	7.4	400 x 300	720,000
Gravel	Dry dense reddish brown Clayey SANDs with cobbles	Bugongo LC1	2	100 x 200	80,000
	Dry dense reddish brown Clayey SANDs with cobbles	Kabukwenda LC1	1.5	200 x 100	60,000
	Yellowish brown Clayey Silty SANDs with gravels	Kihihi	4	300 x 250	175,000
	Reddish brown Clayey Sandy GRAVEL	Kanyantorogo	6	400 x 500	600,000
Rock	Granite	Kabukwenda	10	100 x 300	100,000
	Granite	Kabukwenda	22	1000 x 300	1,500,000


Bugongo BP


Kabukwenda BP


Kanyantorogo BP


Kihihi BP

Kabukwenda Clay

Quarry source 1

Quarry source 2

Kiruruma Sand

It shall be noted that regarding the above identified sites presented in Table 2-12, and any other facilities borrow pits and dumpsites, risk management assessment by E&S specialists shall be expected on use of existing material sources or new sources to be established by the contractor.

According to the updated ICRP Environmental and Social Management Framework (ESMF) of May 2024 (page 11), future auxiliary facilities that are to be established as part of the Matanda Irrigation Scheme project especially material extraction sites such as stone materials (stone aggregates, stone dust and hard core), borrow areas for murram, sand and clay needs whose exact details could not be ascertained at the time of ESMF preparation. Such sites shall also be subjected to independent environmental and social screening processes as well as appropriate environmental assessments. The ESMF also requires contractors to procure construction materials such as stone-aggregates, marram, clay and sand from sources which have been approved by the National Environment Management Authority (NEMA).

In addition, the ESIA Environmental and Social Management and Monitoring Plan (ESMMP) in Table 9-3, requires the contractor to procure construction materials from sources that are legitimate or licensed by the National Environment Management Authority (NEMA) to avoid degradation of the environment and natural resources. The contractor shall therefore adhere to the provisions of the National Environment Act of 2019 and the Environmental and Social Impact Assessment Regulations of 2020 while screening, assessing the sites and eventually utilizing the licensed material sources.

2.5 Construction Phase

During the construction phase, the dam, spillway, intake and bottom outlet, irrigation networks, drainage networks (primary, secondary and tertiary distribution lines), and other structures will be put in place. This will include activities such as further site clearance, excavation, blasting and surfacing of cleared areas. This is projected to take a period of five years.

River diversion during dam construction will take the following steps;

Step 1. Excavating a diversion channel large enough to convey a flood of a desired return period, the excavated material is placed on the riverbank, during this process the river continues flowing through the natural course. Clear management procedures shall be included in the contractor excavation methodology.

Step 2. Import the excavated material and place it as a coffer dam/dyke so that the river flows through the diversion channel downstream.

Steps to construction of the dam in the scheme

These can be a summary of the activities to be undertaken in an irrigation dam facility construction much as they may not really be sequential *per se*. They include:

a) ***Site investigations****:* Before construction of the dam commences the site will be subjected to a host of thorough engineering investigations to establish the nature of the foundation, and to locate sufficient suitable clay material to use in the embankment. Test pits will be excavated, and soils subjected to through geotechnical tests. Investigation of the foundation of the dam will equally be done to ensure that it will not fail and cause the embankment to fail.

b) ***Engineering:*** During dam construction, specialized engineering supervision will be required. The level of specialized engineering supervision required is generally proportional to the size and anticipated hazard category of the dam. Appropriately qualified and experienced engineer services will be required during dam construction to ensure the infrastructure under construction is being done to the required and applicable standards and specification as in the design provisions. Engineering expertise can be used during the planning, and construction of the dam, as well as throughout the life of the dam.

c) ***Clearing:*** The area to be covered by the embankment shall be pegged out prior to commencement of any works. The embankment and the area to be excavated shall be cleared and grubbed. Topsoil shall be stock-piled in areas outside of the area to be covered by the embankment and all trees, scrub and roots removed. Topsoil shall be stock-piled in layers not exceeding 200 mm and planted with grass if it is to be left for a considerable time (more than 6 months). This will conserve the integrity of the topsoil. All loose and unusable material in the embankment area has to be removed clear of the site and must not be used in the embankment construction.

d) ***Borrow pits*****:** The full excavation for embankment material, will be kept as much as possible below the full supply level of the storage area. Excavating suitable materials within the wetted perimeter of the storage will maximize the total storage potential. Otherwise, suitable material to construct the dam will be sourced outside the wetted perimeter from borrow pits. Great care will be taken when obtaining borrow materials from steep bank areas that may be prone to instability. A person shall never enter an excavation that is deeper than chest level unless the excavation has been made safe from collapse.

e) ***Foundation:*** The base of the embankment is to be stripped of all topsoil, silt, loose material, vegetable matter, and then scarified over its whole area.

f) ***Embankment compaction:*** Leaks in earth-filled dams that lead to dam failures are often the result of inadequate compaction levels as such, it is important that effective compaction is achieved, and this can be by applying the required compaction effort to high clay content materials. Compaction shall be undertaken by using a tamper foot roller, commonly referred to as a sheep foot roller.

g) ***Settlement of the embankment:*** Settlement of soil banks is common, and an allowance must be made for settlement of the dam embankment. The embankment may settle to a level where it is overtopped by water and failure will result. Or overtime settlement may result in the height of the embankment becoming lower than the spillway. Clay soil can settle in excess of 10% of the dam's height, but well-constructed and compacted clay dam embankments are not likely to settle more than about 5%. An allowance of 5% of the height of the embankment (along its length) to cater for settlement is necessary.

h) ***Planting of vegetation:*** Topsoil shall be spread over the exposed surfaces of the embankment to a depth of at least 150mm and sown with pasture grass to establish a good cover as soon as possible. Always, it is important to ensure that vegetation shall not be higher than knee-height on or near the embankment. Treeroots can cause the core to crack, resulting in the failure of the dam as such, no trees shall be allowed to establish on the embankment as such, trees and shrubs shall be kept to a minimum distance of 1½ times the height of the tree away from the embankment of the dam.

i) ***Cut-off trench or keyway:*** Dams lose water through evaporation and seepage. Little can be done for evaporation losses, but with good construction methods seepage losses can be reduced. One critical aspect is the construction of the cut-off trench. This keyway will minimize seepage under the embankment and increase the stability of the dam. It shall be taken down to a minimum of 600mm into impervious soil and rock and backfilled with the appropriate quality clay that is thoroughly compacted. It shall extend for the length of the embankment including the hillside flanks but shall not need to be extended under the spillway where the spillway is cut into rock.

j) ***Outlet pipe:*** An outlet pipe will be installed in the base of the dam. It is also required to allow water in the stream, upstream of the construction work to be bypassed during construction. The minimum size outlet pipe is to be specified in the project design. However, if need for a specific size pipe to suit the pump/irrigation plant it is recommended that dedicated pipe work also be installed for that purpose. Every precaution is to be taken with the installation of the pipe, given the fact that a large percentage of dam failures are associated with poor installation of outlet pipes.

k) ***Protection from wave action:*** Where the dimensions of the surface of the stored water are such that the prevailing winds will cause wave action on the embankment, protection of the upstream face of the dam is to be provided in the form of stone pitching or rip-rap and this will depend on the design.

l) ***Filling of the dam:*** Once construction of the dam is complete; the dam will be inspected thoroughly ahead of time before it fills with water. The dam shall be filled as slowly as possible, preferably not more than 0.3 metres depth per day to let the new embankment adjust to the increasing water loads. The need for caution cannot be overstated because breaching of the dam and the resulting wave of water may cause considerable damage to the facility.

m) ***Maintenance and inspections:*** Regular maintenance and inspections are required to ensure the dam remains in a good operating condition.

The water works will involve laying of distribution pipelines, connecting the main to secondary and tertiary lateral lines in the 20 ha blocks with hydraulic components installation. This will include pressure testing of various lines and sections. This will be followed by decommissioning of all project structures not required during the operation phase of the Project, including workshop structures and workers' camps, will be demolished and the debris disposed of in a legally acceptable manner. Any waste on the project site at the end of the construction period will be properly disposed of. The Project site will be reinstated to as near as possible its original state. Landscaping and grassing of degraded areas will be done.

2.6 Operational Phase

The operational phase of this project basically refers to the time after construction activities have ended and water from River Kiruruma is being supplied at the 20-ha blocks in the 4420-ha design command area for irrigation. Whereas the dam is to serve total of 9000 Ha, the pipeline network distribution only covers 4420 Ha under the current design.

Maintenance: The dam, control building, pipelines and other structures will require maintenance. Maintenance works consist of routine maintenance and periodical maintenance. Periodical maintenance shall entail planned and recurrent activities performed at predetermined intervals to ensure continued operational efficiency, reliability and safety of Matanda Dam e.g. vegetation control, erosion control, sediment removal, trash and drainage. In addition, emergency maintenance works (unexpected breakdown or change in condition that results in an immediate threat to health and safety) shall also be undertaken at Matanda Dam. The routine maintenance is a day-to-day maintenance work including cleaning silt at flow measuring devices, removal of floating debris, minor repair of pipes and structures and greasing or oiling of gates of facilities. Whereas periodical maintenance is to be done at a certain interval, after harvest season or before planting season.

2.7 Decommissioning Phase:

All project structures and construction materials not required during the operation phase of the project, including workshop structures and workers' camps, will be removed and demolished and the debris disposed of in a legally acceptable manner. Any waste on the project site at the end of the construction period will be properly disposed of. The project site will be reinstated to as near as possible its original state. Landscaping and grassing of degraded areas will be done.

2.8 Project Cost

The unit cost (cost per hectare) is worked out to finalize the best feasible scenario of the scheme. The unit cost per hectare along with the basic parameters is as follows.

Table 2-13A: Project Estimated Cost

Scenario	Command Area	FRL	Storage @ FRL	Cost of Scheme	Capital Cost per Ha
	(Ha)	(m)	(MCM)	(MUSD)	(USD)
Scenario-A	**4,420**	**1259**	**11.18**	**51.11**	**11,564**
Scenario-B	**9,000**	**1265**	**22.7**	**78.16**	**8,684**
ESMMP Implementation and compliance enforcement costs					**1,688,486**

Table 2-14B: Costs for Compensation, Dam Safety Plan and Capacity Building (USD)

S.N	Item	Source Document	Amount (USD)
1	Compensation	RAP Report	7,724,324
2	Dam Safety Plan	0.5% of the investment cost	103,500
3	Capacity Building	Updated ESMF of May 2024	260,000
Total			**8,087,824**

Table 2-15: Estimated Project Investment Cost (USD)

S.No	Description of Item	Cost (M$)	
		Scenario A - 4,420ha	Scenario B - 9,000ha
A.	**DAM CONSTRUCTION COSTS**		
1	Premilinaries	1.20	1.20
2	Site Installations and Services	1.45	1.45
3	River diversion works	0.89	0.89
4	Spillway Section	3.84	4.83
5	Non-Overflow Dam	6.96	7.38
6	Dam Instrumentation	0.50	0.50
7	Dam Contingency	0.72	0.79
8	Spillway Bridge	1.05	1.05
	Sub-total 1	**16.60**	**18.09**
B.	**IRRIGATION NETWORK COSTS**		
9	Premilinaries	2.54	2.54
10	Cost of the main pipe works up to a 20Ha Block	14.22	28.43
11	Cost other works including earth works, fittings, and chambers etc. to 20Ha Block	4.13	8.26

S.No	Description of Item	Cost (M$)	
		Scenario A - 4,420ha	**Scenario B - 9,000ha**
12	Cost of pipe network within the Block (Onfarm Irrigation Infrastructure)	11.98	17.97
13	Network Contingencies	1.64	2.86
	Sub-total 2	**34.51**	**60.06**
	TOTAL COST (A+B)	**51.11**	**78.16**

POLICY, LEGAL, REGULATORY AND INSTITUTIONAL FRAMEWORK

3 POLICY, LEGAL, REGULATORY AND INSTITUTIONAL FRAMEWORK

This section discusses national policies, laws and regulations relevant for successful construction and operation of the Matanda Irrigation Scheme in an environmentally and socially sustainable manner. The linkage of each of the cited policies, laws and regulations with the proposed project has been provided. A list of permits or licenses and plans that will have to be obtained before project implementation is given. An institutional framework showing agencies likely to be associated with the project and their roles has been elaborated in Section 3.3.

3.1 National Policy Framework

3.1.2 The National Environment Management Policy, 1994

The overall goal of this policy is the promotion of sustainable economic and social development, mindful of the needs for future generations. ESIA is one of the vital tools considered necessary to ensure environmental quality and resource productivity on a long-term basis. The Policy requires that projects or policies likely to have significant adverse ecological or social impacts undertake an ESIA before their implementation.

Relevance to this Project: In line with this policy, this ESIA study was conducted to take into consideration any social-economic and environmental impacts anticipated from the scheme construction and operation for achievement of productivity and resilience to climate change agriculture. The management and monitoring plans developed as a result of the findings of this study will serve for sustainability of the scheme.

3.1.3 Uganda National Land Policy, 2013

The overall goal of the Policy is to ensure an efficient, equitable and optimal utilization and management of Uganda's land resources for poverty reduction, wealth creation and overall socio-economic development. One of the guiding principles of the Land Policy is effective regulation of land use and land development. Objectives vii of this policy is to ensure planned, environmentally-friendly, affordable and orderly development of human settlements for both rural and urban areas, including infrastructure development.

Relevance to this Project: Section 74 (i) states that where it is necessary to execute public works on any land (e.g., construction of water works including the dam and the inundation in the upstream area (259ha), an authorized undertaker shall enter into mutual agreement with occupier or owner of the land in accordance with this act hence the scheme RAP study.

3.1.4 National Gender Policy, 2007

The Uganda National Gender Policy was first developed in 1997 and revised in 2007 as a confirmation that the Ugandan government is committed to take actions that will bring about more equal gender relations. The

goal of this policy is to mainstream gender issues in the national development process in order to improve the social, legal/civic, political, economic and cultural conditions of the people of Uganda, particularly women. The policy was designed to guide and direct at all levels of planning, resource allocation, and implementation of development programmes with a gender perspective.

Relevance to this project: The gender policy recommends integration of gender issues in national policies and projects. This project will require labour during construction, and operation and maintenance phases. During the construction phase, to the extent possible, equal employment opportunities shall be available for women. To effect this; MWE will require the contractor to; develop a gender management plan, using locally available labour including women depending on the level of skills required vis à vis what is available. The contractor will be required to provide a work environment that is conducive to women as well as for men. Women-owned entities will be prioritized during awarding service contracts; in regard to preparation and supply of foodstuffs to contractors' staff. It also defines the Ministry of Gender, Labour and Social Development (MGLSD) as a major project stakeholder, specifically Gender Department.

3.1.5 National Water Policy, 1997

The National Water Policy promotes a new integrated approach to manage the water resources in ways that are sustainable and most beneficial to the people of Uganda. The goal of this policy is to provide guidance on development and management of the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs, with full participation of all stakeholders and mindful of the needs of future generations. The policy aims to:

- Promote rational use of water;
- Control pollution and promote safe storage, treatment and disposal of waste, which could pollute water and impact public health; and
- Promotion of awareness of water management and development issues and capacity building.

Relevance to this Project: Matanda Scheme infrastructure development activities, including; Dam construction and associated headworks result in inundation in the upstream areas; Construction of irrigation networks, and on-farm irrigation works in the downstream, irrigation command area (9000ha), will be guided by this policy in respect to conserving and protecting the current ecosystem at and around the proposed project area.

3.1.6 Occupational Health and Safety (OHS) Policy

This policy seeks to:

- Provide and maintain a healthy working environment;

- Institutionalize OHS in the water-sector policies, programs and plans; and
- Contribute towards safeguarding the physical environment.

The OHS Policy Statement is guided by the Constitution of the Republic of Uganda and other global, national and sectoral regulations and policies. The OHS Policy also takes into account the Health Sector Strategic Plan, all of which aim to improve the quality of life for all Ugandans in their living and working environment.

Relevance to this Project: This policy calls for scheme labour conditions safeguards such as, the contractor bearing an Occupation, Safety & Health Management Plan, Emergency Response and Incident Management Plan, Induction of all workers including subcontractors and casual labourers, toolbox meetings, and PPE usage for protection of the public from health and safety impacts as a result of project construction and subsequent operation and maintenance activities.

3.1.7 National AIDS Policy, 2004

Current effort to combat HIV/AIDS is characterized by a policy of openness by the Government and this has, to a large extent, been emulated by civil society, political and social institutions, and workplaces. HIV/AIDS is recognized by Ministry of Health as a considerable risk in construction of infrastructure projects and together with the Ministry of Gender, Labour and Social Development encourage employers to develop in-house HIV/AIDS policies; provide awareness and prevention measures to workers and avoid discriminating against workers living with or affected by HIV/AIDS; protect the infected and affected persons from discrimination, employers are required to keep personal medical records confidential. Employees living with, or affected by, HIV and AIDS, and those who have any related concerns, are encouraged to contact any confidant within the organization to discuss their concerns and obtain information. It is anticipated that during the construction phase, there may be an influx of people into the project area possibly resulting into sexual fraternization and a risk of HIV/AIDS spread.

Relevance to this Project: The implementation of this project will require labour for the construction, operation and maintenance of the scheme which may increase HIV/AIDS perseverance in the command areas hence the need for social- health baseline studies and establishing the level of health sensitization under this policy. The policy according to (MP, July 2007) clearly defines;

Role of Contractor;

- *Formulation of a sound HIV/AIDS policy, around the principle of non-discrimination, equality, confidentiality, care and support for the project.*
- *Develop an equitable set of policies that are communicated to all staff and properly implemented, including protection of the rights at work and protection against any discrimination at work.*
- *Develop a step-by-step action plan taking on all the legal, ethical, social and economic aspects.*
- *Identify the factors that influence HIV/AIDS transmission in terms of organizational, structure/activities, examine existing workplace practices and policies; establish the real and/or potential impact of HIV/AIDS on the company and its workforce.*

- *Ensure that induction programs for new workers include training on HIV/AIDS.*
- *Initiate and develop HIV/AIDS prevention and care programmes, designed not only to protect the infected workforce, but also to take into account the rights and problems of those living with HIV/AIDS.*
- *Provide and maintain as far as is practicable, a working environment that is safe and without risk to the health of its workers, including occupational transmission of HIV.*
- *Ensure that the rights of workers with regard to HIV/AIDS and the remedies that are available in the event of breach of such rights become integrated into existing grievance procedures.*
- *Responsible for the implementation of this policy.*
- *Mainstream HIV/AIDS activities into the workplace policies and programs.*

Role of Workers;

- *Initiate dialogue on HIV/AIDS between employers and workers and to actively participate in the development and implementation of workplace prevention programmes i.e. awareness campaigns, dissemination of information and education, care and support.*
- *Participate in the development of workplace policies.*
- *Participate in mainstreaming of HIV/AIDS into the workplace policies and programs.*

3.1.8 Environment Health Policy -2005

The Environmental Health Policy concentrates on the importance of environmental sanitation which includes safe management of human waste and associated personal hygiene; the safe collection, storage, and use of drinking water; solid waste management; drainage; and protection against disease vectors (MOH 2005). Environmental health practices include safe disposal of human waste, hand washing, adequate water quantity for personal hygiene and protecting water quality, all influence the morbidity and mortality of diarrheal diseases.

Relevance to this Project: The Environmental Health policy will guide implementation of public health and hygiene intervention measures on the project. As per this study, the public health aspect has been given adequate attention in preparation of this ESIS; aspects included water and sanitation facilities for the construction crew during the construction and operational phase respectively.

3.1.9 National Irrigation Policy, 2018

This policy serves as the overarching instrument for regulation of irrigation development in the country. Objective (ii) of the policy calls for promotion of Integrated Water Resources Management approach in irrigation planning, development and management whereas objective (vi) ensures reliable water for irrigation to optimize, intensify and diversify crop, livestock and fisheries production and productivity. In retort to the policies target of achieving an additional one Million, Five Hundred Thousand Hectares (1,500,000 Ha) under irrigated agriculture (constituting 50% of irrigation potential) by 2040, it shallers sustainable protection, use,

and management of key natural resources including water resources, air, wetlands, land/soils and environment to support irrigation and other uses through the Environmental Principles (v) and Water use Efficiency (vii) on the government.

Relevance to this Project: The proposed scheme is aimed at promoting Integrated Water Resources Management approach in irrigation planning, development and management through ensuring reliable water for irrigation in the project command area to optimize, intensify and diversify crop production and productivity as per policy objectives. The policy recognises the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) as a major project stakeholder in the implementation of onfarm activities including agronomy support, agribusiness and infrastructure operation and maintenance.

3.1.10 National Sanitation Policy 1997

The goal of this policy is to promote and preserve the health of the community through improved sanitation. Attaining and maintaining a good standard of sanitation will greatly contribute to reducing mortality and morbidity from sanitation related diseases as well as improving the socio-economic status of the community. Besides pollution of underground water sources, lack of adequate sanitation is also a major threat to the environment. Indiscriminate disposal of solid, human and liquid wastes is responsible for eutrophication of the freshwater lakes. The policy therefore guides and facilitates individuals, institutions, community leaders of all kinds and all levels, families and communities to contribute to achieve optimal, sustainable sanitation standards and thereby improving their quality of life and eradication of poverty.

Relevance to this Project: The policy will guide implementation of good sanitary intervention measures on the project. As per this study, the sanitation aspect has been given adequate attention in preparation of this ESIS, aspects included water and sanitation facilities for the construction crew during the construction and operational phase respectively.

3.1.11 Uganda National Culture Policy, 2006

The policy delineates the cultural heritage of Uganda as artistic and cultural expressions, including; language and literary arts, performing arts, visual arts and handicrafts, indigenous knowledge, cultural beliefs, traditions and values, cultural sites, monuments and antiquities. It further distinguishes the people of Uganda as; 65 indigenous communities (as per Constitution of Uganda- Schedule 3) representing Uganda's diverse cultural heritage and; non-indigenous communities, of whom, some are a result of intermarriages between some indigenous people with foreigners while others are foreigners who live in Uganda. Basis on the policy's four objectives are to; promote and strengthen Uganda's diverse cultural identities; enhance social cohesion, collaboration and participation of all people in cultural life; promote community action on cultural practices that promote and that impinge on human dignity; and conserve, protect and promote Uganda's tangible and intangible cultural heritage.

Relevance to this Project: The policy advocated for social-cultural baseline studies in the project area for such a project under this study, since it's predicated that many workers from various places of the country or region, with various cultures may be employed on the project. Consultation of the Batwa leaving the project command area, was enacted by this policy delineation of the tribe as an Indigenous Community. The policy also defines the Ministry of Gender, Labour and Social Development (MGLSD) as a major project stakeholder, specifically the Department of Culture.

3.1.12 Uganda National Climate Change Policy, 2012

The policy objectives call for; identification and promotion of common policy priorities, adaptation, mitigation monitoring, detection, attribution and prediction policy responses to address climate change in Uganda. Specifically, objective (v) calls for integration of climate change issues into planning, decision making and investments in all sectors. All these objectives are aimed at ensuring a harmonized and coordinated approach towards a climate- resilient and low-carbon development path for sustainable development in Uganda.

Relevance to this Project: Section 4.2.1: Sector-Specific priorities for Agriculture and Livestock, irrigation systems that use water sustainably for irrigated agriculture such as this project, are encouraged to promote climate change adaptation strategies like creation of bulk water storage reservoirs by dam construction for use in the downstream command area, that enhance resilient, productive and sustainable agricultural production systems in Uganda. Therefore, appropriate mitigation measures and irrigation monitoring strategies were devised under the ESMMP to achieve the overreaching and specific objectives of this policy.

3.1.13 National Agricultural Policy, 2013

The overall objective of the agricultural policy is to achieve food and nutrition security and improve household incomes through coordinated interventions that focus on enhancing sustainable agricultural productivity. Agriculture has been and continues to be the most important sector in Uganda's economy because it employs the largest proportion of the population. The policy emphasizes that agriculture has the potential to be a significant source of economic growth and poverty reduction. It further highlights that managing agriculture shall be through a multi-sectoral approach. It requires strong cross-sectoral coordination and accountability because the mandates for various interventions fall under different ministries and agencies across government, both at the centre and in local governments. The Ministry of Agriculture Animal Industry and Fisheries (MAAIF) is responsible for managing and coordinating agricultural policies and interventions. It does so through the Ministry's autonomous and semi-autonomous agencies, local governments, other ministries, departments and agencies (MDAs), private sector, civil society and development partners.

Relevance to this Project: Backbone to this project's objective is to increase productivity and resilience to climate change and diminish reliance on erratic rains through modernizing agriculture by development of bulk water reservoirs and irrigation infrunstructure networks to promote irrigated agriculture. The government seeks to support farming communities in Matanda with an irrigation scheme aimed to improve agricultural

productivity, food security and livelihoods through irrigation. This intervention would promote; strategic, profitable and sustainable use and management of agricultural resources through promotion of block farming agriculture; sustainable agricultural production all-year round and alleviate socio-economic impacts of low productivity in rain-fed agriculture. The same policy defines the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) as a key stakeholder for this project.

3.1.14 The National Fisheries and Aquaculture Policy, 2018

The Policy supports the creation of decent employment; increase household and national incomes; food and nutritional security. The Policy vision is "A modern, productive, profitable and sustainable fisheries and aquaculture sub-sector". The goal is to increase fisheries and aquaculture production to 1.7 million tonnes annually. The Policy identified the following essential areas to achieve targets, i.e., i) Fisheries and Aquaculture Management and Governance, ii) "Production and Productivity", iii) Research and Appropriate Technology Transfer among others. Thus, the need for strengthening the capacity for the management of fisheries resources, promoting the development of appropriate technologies in response to fisheries needs and ensuring adequate fish stocks through conservation of critical habitats, effective regulation and fishing capacity management, stock enhancement. The policy also emphasizes the need to strengthen lake management organizations to work better with the district local governments, local user communities, private sector, and fisher groups.

Relevance to this Project: River Kiruruma is endowed with a variety of fish species that thrive throughout the different river sections, especially during the wet and high-water level seasons. All the species recorded under the biodiversity study are listed under the IUCN Red list of Threatened species and National Red List for threatened species by WCS as Least Concern (LC). Therefore, no species of conservation concern was encountered in the command area. However, this project will promote the growth of fish and the fisheries industry, hence ensuring increased and sustainable fish production in fulfillment of the policy objectives and strategies.

3.1.15 National Policy on Elimination of Gender-Based Violence (GBV) (2016)

The policy provides a framework for implementing comprehensive GBV prevention measures and multi-sectoral support services for survivors. Under these provisions, the project will be required to prepare a gender action plan to support the project workers and the community during project implementation. Therefore, the policy seeks to promote, prevent, respond to, and end impunity of gender-based violations in the country. The highest prevalence of gender-based violence is among women aged between 15 and 45 and generally involves sexual violence.

Relevance to this Project: The proposed project shall have a specific policy on eliminating gender-based violence throughout the project phases. This will be done by putting up an anti-sexual harassment policy, a workers' code of conduct, and an anti-retaliation policy, among others. In addition, the project will require working with community members, police, parents, and all stakeholders to address gender issues specifically.

3.2 National Legislative Framework

3.2.1 The Constitution of the Republic of Uganda, 1995

The 1995 Constitution restored all private land tenure regimes (which had previously been abolished under the Land Reform Decree, 1975). It divested the state and the Uganda Land Commission of radical title to land that was expropriated in 1975 and vested it directly in the citizens of Uganda. The constitution provides that every person has a right to own property and that no person will be compulsorily deprived of property or any interest in or right over property without prompt payment of fair and adequate compensation, prior to the taking of possession or acquisition of the property.

On land tenure regimes and transfer of land, the constitution prescribes tenure regimes in accordance with rights and interests held in land. Article 237 of the constitution, 1995, vests land in the citizens of Uganda and identifies four land tenure systems, namely: customary, freehold, mailo and leasehold. Understanding these systems (detailed in section 4 of the Land Act, 1998) is vital for compensation of households to be affected by the project. These tenure systems are outlined below:

- **Customary tenure:** In this tenure, land is owned in perpetuity and tenure is governed by rules generally accepted as binding and authoritative by the class of persons to which it applies (that is, "customary regime is not governed by written law"). Customary occupants are occupant of former public land, and occupy the land by virtue of their customary rights; they have proprietary interest in the land and are entitled to certificates of customary ownership. Certificates of customary ownership are issued by the District Land Boards, through application to the Parish Land Committee.
- **Freehold tenure:** This tenure derives its legality from the constitution. It involves the holding of land in perpetuity or for a period less than fixed by a condition and enables the holder to exercise, subject to the law, full powers of ownership.
- **Leasehold tenure:** Lease tenure is created either by contract or by operation of the law. It is a form of tenure under which the landlord or lessor grants the tenant or lessee exclusive possession of the land, usually for a defined period and in return for a rental fee. The tenant has security of tenure and a proprietary interest in the land.

For the proposed project area, customary tenure is the prevalent land tenure system.

Objective XXVII (i) requires 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. *This objective petitions for public awareness about the proposed project construction and operational scope and activities including an environmental management and monitoring plan hence was the basis for ESIA consultation as a step for sustainable development.*

Paragraph (ii) of that objective goes ahead to state that the State will take all possible measures to prevent or minimize damage and destruction to land, air and water resources resulting from pollution or other causes. *The Ugandan government enforces this through the lead agencies like NEMA which in turn mandates for an ESIS for the proposed project to mitigate damage to the environment.*

Article 39 preserves the right of every Ugandan to a clean and healthy environment. *The proposed project construction status will be subject to clean, healthy and safe environment practices.*

Relevance to this Project: The implementation of this project will be conducted in a manner that will incorporate the appropriate safeguards for environmental and social issues, especially land take for the dam, reservour in the upstream, water conveyance systems in the downstream, primary and secondary distribution network and scheme roads in the command area.

3.2.2 National Environmental Act, No 5 of 2019

This act repeals, replaces and reforms the law relating to environmental management in Uganda (National Environment Act (NEA), Cap 153-1995). It provides for the management of the environment for sustainable development and mandates the National Environment Management Authority (NEMA) as a coordinating, monitoring, regulatory and supervisory body for all activities relating to the environment. The act also provides sections that are meant to empower NEMA to protect the environment and these include a right to a decent environment Section (3) subsection (1-5).

It is the specific legislation that deals with Environmental and Social Impact Assessments (ESIA) in Uganda and also requires that an ESIA be prepared in accordance with national EIA Guidelines (1997) and EIA Regulations (1998).

Relevance to this Project: According to Schedule Five of the National Environment No.5 of Act 2019, a detailed ESIA for this project is required to be submitted to the Authority (NEMA) on basis of;

Category 4: Utilization of water resources and water supply;

a) Abstraction or utilization of surface water for agricultural, industrial or urban use of more than 21.709 MCM. *Matanda scheme is planned to abstract 21.709 MCM.*
c) Diversion of water from a river or stream, where the water discharged is more than 400 m^3/day or 30% of Internal Renewable Water Resources over the river catchment. *Matanda scheme is planned to divert 21.709 MCM from River Kiruruma.*

Category 6: Agricultural investments, livestock, range management and fisheries;

d) Large scale irrigation of more than 20 hectares. *The command area of the scheme is 4420 Ha.*

This study is therefore in line with the provisions of this law.

3.2.3 The Land Act, Cap 227, 1998

The Land Act provides for tenure, ownership and management of land. Section 44 reiterates the Constitutional mandate for the government or a local government to protect environmentally sensitive areas for the common good of the people in Uganda. Section 45 states that the use of land shall conform to the Physical Planning Act, 2010 and any other law. Section 71 makes provision for the use and maintenance of existing rights of way as reserved to and vested in the Government on behalf of the public. Sections 76 - 77 makes provision for the jurisdiction of district land tribunals in matters of computation of compensation of land and disturbance allowance in the event of land take.

Relevance to this Project: The proposed scheme command area is proposed to cover over 9000Ha which is under jurisdiction of Kanungu District; Kihiihi, Kihiihi Tc, Nyakinoni, Nyamirama, Nyanga, and Kanyantorogo sub counties and villages, identified also as major stakeholders to the project under this Act. The same Act guided the ESIA study in determining the Land tenure system in the command area and the RAP study in identifying the Project Affected Persons (PAPs).

3.2.4 The Survey Act, 1964

Under this Act, where a general survey is necessary, notice of such specifying the local limits of the area affected has to be published in the gazette before the survey is undertaken. It specifies that; only government surveyors or duly authorized officers with servants and workmen may enter upon any land and make all or any inquiries and do or cause to be done all things necessary for effecting such a survey; and obstructing a surveyor when he is carrying out lawful activities is an offense under this Act. With regard to compensation the Act stipulates that where any demand for compensation is made as a result of the clearance of any boundary or other line, a Government surveyor shall, as soon as conveniently may be, inspect any trees, fences, or standing crops which are alleged to have been cut down or damaged, and, if he or she shall consider that any compensation shall be paid, shall pay or tender to the owner of the trees, fences or standing crops the amount of compensation which in his or her opinion shall be allowed for them.

Relevance to this Project: During conduct of the Resettlement Action Plan for the proposed scheme, this Act will guide the adopted detailed survey methodology, including community sensitization with the help of the local leaders in preparation of survey grounds in the delineated areas as per scheme final design.

3.2.5 The National Agricultural Advisory Services Act, 2001

This Act provides for the establishment of the National Agricultural Advisory Services (NAADS), its composition, functions and administration for the promotion of market-oriented agriculture, and to regulate provision of advice and information services to farmers. It provides for registration and deregistration of farmers groups, establishment of farmers' fora at national, district and Sub County levels. The Sub County farmer's forum comprises, (i) two members of the executive committee of every farmers' group in the Sub County, (ii) the secretary for production in the Sub County, and (iii) the Sub County NAADS coordinator.

Relevance to this Project: Based on this Act, under this study, consultations with science based National Agricultural Research Laboratory (NARL), Kawanda, on the suitability of the area for the rice cultivation were conducted as cited by the NEMA approved Scheme ESIA-Terms of Reference (f). During operation of the scheme, there will be need to provide and regulate provision of advice and information services to farmers by the local district administrative authority specifically the Agricultural Department.

3.2.6 The Seeds and Plant Act 2006

This Act provides for the promotion, regulation and control of plant breeding and variety release, multiplication, conditioning marketing, importing and quality assurance of seeds and other planting materials. The act provides for the establishment of a number of administrative units, including (i) the National Seed Board under MAAIF, (ii) National Variety Release Committee - a technical committee which includes, among others, an entomologist, pathologist and weed scientist, and (iii) National Seed Certification Services Committee (NSCSC) responsible for designing and implementing seed certification standards, methods and procedures.

Relevance to this Project During operation of the scheme, new seed varieties and breeds characterized with pest resistance, high quality, low-cost, hybrid, are anticipated to be introduced, of which need to meet set seed certification standards enacted by this Act through NSCSC.

3.2.7 The Agricultural Chemicals (Control Act) 2006

This Act provides for control and regulation of the manufacture, storage, distribution and trade in, use, importation and exportation of agricultural chemicals. It establishes an Agricultural Chemical Control Board that ensures chemicals are duly registered and are used in accordance with the regulations provided under the Act. Requirements under Act such as packaging and labeling of agricultural chemicals are important legal provisions for preventing abuses in pesticide supply and sales.

Relevance to this Project During operation of the project, more agricultural chemicals like fertilizers and pesticides will be applied on crops that will be irrigated. Therefore, this Act will be relevant.

3.2.8 The Local Governments Act Cap 243, 1997

The Local Government Act provides for decentralized governance and devolution of central government functions, powers and services to local governments that have their own political and administrative structures. Districts have powers to oversee implementation of development activities under supervision of their relevant departments such as environment, lands and water resources. According to Section 9 of the Local Government Act, a local government is the highest political and administrative authority in its area of jurisdiction and will exercise both legislative and executive powers in accordance with the constitution. This Act Provides for the system of local governments to enforce environmental law; which includes among others, physical planning, environmental protection (forests and wetlands, streams etc.) and ensuring proper sanitation.

Relevance to this Project: The proposed scheme command area is proposed to cover over 9000 Ha which is under jurisdiction of Kanungu District; Kihiihi, Nyamirama, Nyakinoni, and Kihiihi Tc sub counties and villages, hence key stakeholders to the project under this Act.

3.2.9 The Physical Planning Act, 2020

The Physical Planning Act, 2010 which replaced the Town and Country Planning Act, Cap 246 was amended in 2020. The 1951 Act was enacted to regulate and operate in a centralised system of governance where physical planning was carried out at national level through the Town and Country Planning Board. Implementation of the Act was supervised by local governments, especially the urban local governments. Uganda has since gone through many social, political and economic changes. For example, promulgation of the 1995 Constitution established a decentralised system of governance which divulged powers and functions including physical planning, finance and execution of projects from the central government to local governments. This therefore created a need to enact a physical planning legislation which is consistent with this Constitutional requirement. The Physical Planning Act, 2011 establishes district and urban physical planning committees, provides for making and approval of physical development plans and applications for development.

Section 37 of The Physical Planning Act, 2020 requires an EIA permit for developments before they are implemented, stating: “Where a development application is related to matters that require an environmental impact assessment, the approving authority may grant preliminary approval subject to the applicant obtaining an EIA certificate in accordance with the National Environment Act”.

Relevance to this Project: This project is proposed to be located within Kanungu District; with developed irrigation infrastructure covering 9000 Ha of Kihiihi Sub County, Nyanga, Kihiihi Town Council, Nyamirama, Nyakinoni and Kanyantorogo sub counties, hence has to conform to planning requirements prescribed by the district planning committee, Agricultural and the water office. Clause 32 of the Physical Planning Act

required MWE to use services of a qualified designer engineer (Aarvee associates) to prepare the scheme design from feasibility study.

3.2.10 Employment Act, 2006

The Employment Act, 2006 repeals Employment Act (Cap 219) enacted in 2000 and it is the principal legislation that seeks to harmonise relationships between employees and employers, protect workers interests and welfare and safeguard their occupational health and safety through:

- Prohibiting forced labour, discrimination and sexual harassment at workplaces (Part II; Part IV)
- Providing for labour inspection by the relevant ministry (Part III)
- Stipulating rights and duties in employment (weekly rest, working hours, annual leave, maternity and paternity leaves, sick pay, etc. (Part VI)
- Continuity of employment (continuous service, seasonal employment, etc. (Part VIII).

The Employment Act is also the governing legal statutory instrument for the recruitment, contracting, deployment, remuneration, management and compensation of workers. The Act is based on the provisions of Article 40 of The Constitution of Uganda. The Act mandates Labour Officers to regularly inspect working conditions of workers to ascertain that rights of workers and basic provisions are provided and workers' welfare attended to.

The Employment Act also provides for the freedom of association of workers permitting workers to join labour organizations. Section 32 addresses the issue of child labour and states that children under the age of twelve years will not be employed in any business, undertaking or workplace (32(1)). Subsection 32(2) provides restrictions under which a child under the age of fourteen (14) years may be employed; including for light work under the supervision of an adult aged over eighteen (18) years and the work will not interfere with the child's education.

Relevance to this Project: This project will require workers during construction and operation phases and the Employment Act will be used in guidance of recruitment, adoption of a Labour Management Plan, and contracting, as well as adherence to ILO conventions. The same act calls for local content which may be achieved by use of local leaders in the recruitment process to ensure full and fair participation of local communities and screening out of lawbreakers. This in turn will promote utilization of locally available labour, to the extent possible, depending on the level of skills required visa vie what is available. In addition, the working conditions and workers' welfare, including child labour will be governed by the provisions of this Act. Kanungu District labour officers will also be involved in ensuring compliance with the provisions of the Employment Act for this project.

3.2.11 The Children's Act, Cap 59- 2016

The Children's Act was enacted; to reform and consolidate the law relating to children; to provide for the care, protection and maintenance of children; to provide for local authority support for children; to establish a family and children court; to make provision for children charged with offenses and for other connected purposes. In particular, Section 8 of this Act provides that no child will be employed or engaged in any activity that may be harmful to his or her health, education or mental, physical or moral development in adherence to ILO conventions.

Relevance to this Project: The project will require workers during construction phases and there will not be any employment or engagement of children as per restrictions of the Employment Act to ensure that risks to children are either eliminated or reduced to as low as reasonably practicable as prescribed under the Children's Act, cap 59. In addition, the contractor will confirm the age of potential labourers prior to hiring through National Identity Card, birth certificate or confirming with LC.

The Act further guides that

- *A child under the age of fourteen years shall not be employed in any business, undertaking or workplace, except for light work carried out under supervision of an adult aged over eighteen years, and which does not affect the child's education.*
- *'A child shall not be employed in any employment or work which is injurious to his or her health, dangerous or hazardous or otherwise unsuitable and an employer shall not continue to employ a child after being notified in writing by a labour officer that the employment or work is injurious to health, dangerous or otherwise unsuitable for that child.*

3.2.12 The Penal Code Act, Cap 120, 2007

The Penal Code Act established from code of criminal law. Section 129 criminalizes defilement of girls under the age of eighteen. Section 131 criminalizes procuration of women or girls to become common prostitutes. Sections 136 – 137 criminalizes people who make earnings from prostitution, and Section 139 provides a penalty of imprisonment for seven years for anyone who practices or engages in prostitution.

Relevance to this Project: It's upon the Penal Code Act that the code of conduct guidelines intended to establish and clarify the standards for behaviour in the contractor's company under this project will be developed. The contractor will have to operate in accordance with the provisions of this Act and desist from engaging in commercial or any other type of sexual exploitation of workers and local community members, especially the children. The contractors will also have to put in place strict social safeguards to discourage fraternization with the local community that could result in defilement and rape. It will also be the responsibility of MWE to ensure that the contractors procured do not have any dealings in illegal activities including prostitution. Guidance notes will need to be prepared to analyse the different cases and proposed mitigation action as benchmarked from the ESMMP.

3.2.13 Occupational Safety and Health Act, 2006

The Occupational Safety and Health Act, Section 13, puts the responsibility of protection of the worker and the general environment to the employer and he or she must take all measures to protect the worker and the general public from the dangerous aspects of his or her undertaking at his or her own cost. In section 18, he or she also has the responsibility of monitoring the environment under the influence of his or her undertaking. In section 95, it requires the employer to take all preventive measures including administrative and technical measures to prevent or reduce contamination of the working environment to the level of exposure limits specified by the commissioner.

It also pleas in section 14 (1) that the contractor with more than 20 workers shall;

a) Prepare, and as often as may be appropriate, revise a written statement of policy with respect to the safety and health of employees while at work;
b) Make arrangements for carrying out the statement policy; and
c) Bring the statement of policy and any revision of it to the notice of all the employees.

Section 19 (2) states that it is the duty of the contractor to ensure that personal protective equipment provided under subsection (1) is used whenever it is required. Section 25, mandates that the contractor under; subsection (a) to display or provide guide for safety precautions to any persons who may be affected by the manner in which the project work scope and activities are undertaken, whether or not that person is his or her worker; subsection (b) to display all information in his or her possession or control concerning the way in which he or she conducts the undertaking, which may affect workers health or safety.

Occupational Safety and Health Act also requires that the project construction area shall be registered under section 41 (1) and upon receipts of notice in accordance with section 40, the commissioner will cause, after the appropriate fee is paid, a workplace to be registered and will to an occupier a certificate of registration, in his or her name, in a form prescribed in schedule 4. However, section 49; emphasizes gender sensitivity as per sanitary facilities accentuating that where persons of both sexes are to be employed;

i. Proper, separate accommodation for persons of each sex;
ii. Separate approaches for each sex; and
iii. The convenience for each sex will be indicated by a suitable notice.

Relevance to this Project: In onus for creation of a safe working environment and reduced health risk during construction phase, the contractor shall formulate an Environmental, Social, Health, and Safety (ESHS) plan and acquisition of a work registration permit from Department of Occupational, Health and Safety (OHS) in the Ministry of Gender, Labour and Social Development.

3.2.14 Public Health Act Cap 281-1935

The Public Health Act consolidates the law with respect to public health and puts a duty on urban and local authorities for matters pertaining to public health. Section 7 of this Act provides local authorities with administrative powers to take all lawful, necessary and reasonably practicable measures for preventing the occurrence of, or for dealing with any outbreak or prevalence of, any infectious, communicable or preventable disease, to safeguard and promote the public health.

The Act also specifies about nuisances or conditions liable to be injurious/dangerous to health caused by persons or to persons on premises/ land they occupy or are in charge of. These nuisances include among others, vehicles in a state harmful to health, a dwelling or part of dwelling which is in a state that is dirty or harbours vermin or is damp and is likely to be harmful to health or is liable to favour the spread of any infectious disease, any pit, drain, septic tank, garbage receptacle, manure heap, dung pit so foul or offensively situated and likely to be injurious to health, any noxious matter or waste water flowing or discharged from any premises, wherever situated into any public street, gutter, gulley, swamp or watercourse that is not approved for reception of the discharge.

Relevance to this Project: Proposed project area community health (like malaria prevalence) baseline was required by this Act in the ESIA study as to formulator monitoring indicators in the ESMMP. The Act calls for health insurance, adequate provisions, sanitary facilities, proper solid and liquid waste management, provision of first aid services in all workplaces, an HIV/AIDS prevention and control plan as part of mitigation measures. Environmental health considerations such as project waste management, waste infrastructure, public health and hygiene intervention measures are sought to be in line with this Act. The same policy and Act define the Ministry of Health (MH) as a major project stakeholder specifically Department of Community Health.

3.2.15 Water Act, Cap 152, 1997

The objective of the Water Act is to enable equitable and sustainable management, use, and protection of water resources of Uganda through supervision and coordination of public and private activities that may impact water quantity and quality. Section 18 requires that before constructing or operating any water works, a person shall obtain a permit from Directorate Water Resources Management (DWRM). The Act also aims to control pollution of water resources (Sections 28 and 31). Section 6 (c) implies that it is prohibited to cause or allow any waste to come into contact, whether directly or indirectly, with any water, other than under the provisions of the Water Act.

Relevance to this Project: The proposed scheme will require abstraction of water from River Kiruruma by the construction of Matanda dam, for irrigation. During the construction phase, water will also be abstracted for various construction activities such as dust suppression, compaction works, and concrete mixing. It was therefore imperative that baseline river water quality tests be conducted at the proposed site of abstraction

during the hydrological study. Directorate of Water Resources Management (DWRM), - MWE was identified as a major stakeholder since it's the issuing institution for both construction license and surface water abstraction permits that will have to be sought by the project.

3.2.16 The Historical and Monuments Act, Cap 46-1968

This Act provides for the preservation and protection of cultural and natural heritage of Uganda. It seeks to strengthen administrative structures for effective management of cultural and natural heritage. Section 5 of the Act puts the responsibility of administration, management and regulation of museums and monuments in the Department of Museums and Monuments (DMM) under the Ministry of Tourism, Wildlife and Antiquities while intangible cultural resources shall be administered, managed and regulated by the Ministry responsible for Culture (Ministry of Gender, Labour and Social Development). In addition, Section 6 of the Museums and Monuments Act 2023 empowers the Minister responsible for Tourism, Wildlife and Antiquities to provide policy guidance to DMM, undertake resource mobilization for conservation and preservation of museums and monuments, and coordinate with other relevant government ministries, departments and agencies in conservation and preservation of museums and monuments. In section 7 of this Act, the Minister responsible for Culture is mandated to provide policy guidance on the management of intangible cultural heritage of Uganda. Under Section 66 (1) -(2) of the Act, prohibits destruction, alteration and defacing of cultural and natural heritage resources is prohibited and /or breach of regulations thereof and prescribes a fine not exceeding five hundred currency points or a prison term of seven years or both.

Relevance to this Project: Any objects, material or infrastructure that were identified falling under the category of 'archaeological pale-ontological ethnographical and traditional interests' were documented in chapter 5 of this ESIS. However, any archaeological finds recovered during the project implementation stage will be handled and managed as provided by this Act. A procedure for handling any 'chance find' during project implementation has been prepared for the protection of Physical Cultural Resources (PCRs) as part of the guiding document to the contractor. The enhancement measures have also been included in the ESMMP.

3.2.17 Workers' Compensation Act, 2000

Section 28 of The Workers' Compensation Act (2000) states that:

i. Where a medical practitioner grants a certificate that a worker is suffering from a scheduled disease-causing disablement or that the death of a workman was caused by any scheduled disease; and,
ii. The disease was due to the nature of the workers' employment and was contracted within 24 months immediately previous to the date of such disablement or death, the worker or, if he or she is deceased, his or her dependents shall be entitled to claim and to receive compensation under this Act as if such disablement or death had been caused by an accident arising out of and in the course of his or her employment.

Relevance to this Project: *Labour force will be required during both the construction phase (excavating, setting, concretizing) and operational phase (growing crops, maintaining the scheme) of the irrigation schemes, these will have to abide and also be protected by this policy and Act. For instance, clinical attention in case of any injury at work will also be drawn from the Workers Compensation Act Cap 225 for the workers contracted for this project scope hence the requirement of Occupational Health and Safety plans under the ESMMP. The same policy and Act define the Ministry of Gender, Labour and Social Development (MGLSD) as a major project stakeholder, specifically OHS Department.*

3.3 National Regulatory Framework

3.3.1 Environmental Impact Assessment Regulations, 2020

The Environmental Impact Assessment Regulations require a detailed study to determine possible environmental impacts and mitigation measures. The guidelines require that the EIA process shall be participatory, engaging the general public and stakeholders in consultations or to inform them and obtain their views about the proposed development during the EIA.

- Under section 12 (1) A developer of a project under section 113 of the Act and set out in Schedule 5 of the Act shall undertake scoping and an environmental and social impact study in accordance with these Regulations.
- Under section 13 (1) A developer required to undertake scoping and an environmental and social impact study under section 113 of the Act and regulation 12, shall initiate the study by undertaking a scoping exercise in accordance with the EIA Guidelines issued by the Authority.
- Under section 15 (1) Upon approval of the terms of reference, the developer shall undertake an environmental and social impact study.
- Section 16(1) The developer shall, in undertaking the environmental and social impact study, carry out consultations with relevant stakeholders, communities likely to be affected by the project and the public.
- Section 17 (1) The developer shall prepare an environmental and social impact statement on completion of the environmental and social impact study under regulations 15 and 16.
- Schedule 5: Format of Environmental and Social Impact Statement.
- Under section 4, a developer shall not implement a project to which these Regulations apply without a certificate of approval of EIA issued by the Authority in accordance with the Act and these Regulations.

Relevance to this Project: This ESIA study was conducted with the guidance of these regulations. During this study, various stakeholders have been informed of the project concept, and widely consulted for their views on the proposed construction and establishment of the project. This ESIS was conducted with the guidance of the Environmental Impact Assessment Regulations, 2020.

3.3.2 Draft National Air Quality Standards, 2006

Baseline ambient air quality measurements were carried out to guide the project monitoring phase in anticipation of impact of dust by the project in the project area. The Draft National Air Quality Standards (Table 2-15) will provide regulatory limits for various pollutant emissions as presented in the table below.

Table 2-15: Draft National Air Quality Standards

Pollutant	Averaging time for ambient air	Standard for ambient air
Carbon dioxide (CO_2)	8 hrs	9.0ppm
Carbon monoxide (CO)	8 hrs	9.0ppm
Hydrocarbons	24 hrs	5 mg m^{-3}
Nitrogen oxides (NO_x)	24 hrs 1-year arithmetic mean	0.10 ppm
Smoke	Not to exceed 5 minutes in any one hour	Ringlemann Scale No.2 or 40% observed at 6m or more
Soot	24 hrs	500 µg/Nm^{-3}
Sulphur dioxide (SO_2)	24 hrs	0.15 ppm
Sulphur trioxide (SO_3)	24 hrs	200 µg/Nm^{-3}

Source: Draft National air quality standards, 2006. Note: ppm=parts per million, "N' in µg/Nm^{-3} connotes normal atmospheric conditions of pressure and temperature (25˚C and 1 atmosphere).

Relevance to this Project: These regulations are relevant to the Project as the construction activities may generate dust/particulates that affect the air quality. This regulation explicitly makes the contractor responsible for ensuring that the air quality is kept within acceptable limits during the project implementation.

3.3.3 National Environment (Noise Standards & Control) Regulations, 2003

Section 7 of these regulations requires that no person shall emit noise in excess of permissible noise levels, unless permitted by a license issued under these Regulations (Figure 2-16). Section 8 imparts responsibility onto noise generators to use the best practicable means to ensure that noise does not exceed permissible noise levels. Part IV of the First Schedules states the maximum permissible noise levels at construction sites as 75 dBA and 60 dBA for commercial and residential areas respectively.

Maximum Permissible Noise Levels for Construction Site

Column 1	Column 2	
Noise Control Zone	**Sound Level dB (A) (Leq)**	**Sound Level dB (A) Leq**
	Day	Night
Residential	60	40
Commercial	75	50
Industrial	85	65

Time Frame:

Day : 6.00 a.m - 10.00p.m.

Night : 10.00p.m - 6.00a.m

The time frame takes into consideration human activity.

Source: National Environment (Noise Standards & Control) Regulations, 2003

Figure 2-16: National Noise standards for construction site

Relevance to this Project: The National Noise Standards & Control Regulations are relevant to the project as the construction activities may generate noise. It prescribes allowable night and day-time noise limits that shall not be exceeded in different land use locations. This regulation explicitly makes the contractor responsible for ensuring that noise levels are kept within acceptable limits during the project implementation.

3.3.4 National Environment (Waste Management) Regulations S.I. No. 49 of 2020

These Regulations apply to:

- all categories of hazardous and non-hazardous waste;
- Storage and disposal of hazardous waste and its movement into and out of Uganda.

The regulations, which will relate to overall waste management (promote and minimise waste generation) during the construction phase, by:

- eliminating use of toxic raw materials;
- reducing toxic emissions and wastes;
- Recovering and reuse of waste wherever possible.

Relevance to this Project: All waste generated from the proposed project will be handled in line with these regulations. Among other requirements prescribed in these regulations, the proponent is required to hire a NEMA licensed waste contractor to undertake transportation and disposal/treatment of hazardous waste.

3.3.5 National Environment (Conduct and Certification of Environmental Practitioners) Regulations, 2003

Section (1) of part 1 of the firth schedule cites that an Environmental Practitioner shall not act for any developer, owner or operator unless he or she has received written instructions from that person, or his or her authorized agent. This is reaffirmed by section (2) which requires for terms of the contract between the developer owner or operator and the Environmental Practitioner. The regulation under part 2 of the same schedule, call 13(1) an Environmental Practitioner to undertake due care and diligence in collection of the relevant data to address the significant environmental issues in the various stages of the assessment process and (22) to ensure that all work undertaken by him or her is carried out in accordance with applicable standards and best practice. Once the assessment has been fully conducted, (9) Environmental Practitioner shall submit the environmental impact statement to the developer who shall submit such document directly to the Authority.

The same regulations intricate 35 (1) Every Environmental Practitioner who has been certified and registered under these Regulations shall be professional subject to the Code of Practice and the Professional Ethics prescribed in the Fifth Schedule.

Relevance to this Project: The client (MWE) in adherence to the requirements of the regulations engaged a registered environmental firm (Air Water Earth Ltd-CC/EP/010/22) bearing a competent team of registered environmental practitioner's under NEMA to undertake the project ESIA.

3.3.6 National Environment (Audit) Regulations S.I. No. 47 of 2020

The Audit Regulations operationalize Section 126(2) of the National Environment Act (2019) and Section 54 of the National Environment (Environmental and Social Assessment) Regulations (2020), in which it is a requirement for on- oing activities, which are likely to have environmental impacts to be subjected to an environmental audit in at least 12 months and at most within three years after the commencement of the project.

These regulations also give unfettered powers to a designated environmental inspector to enter and inspect premises for regulatory non-compliance. The regulations require facilities to undertake annual audits and submit findings thereof to NEMA. Facility owners can also conduct a voluntary audit to assess the state of regulatory compliance. Findings of a voluntary environmental audit are confidential; belonging to the facility owner or operator and s/he is not obliged to submit them to NEMA. This annual audit is in fulfillment of requirements of these regulations.

Relevance to this Project: This Regulation is relevant to the project as it keeps the operations of the project in-check with regards to the approval conditions stipulated in the approval permit issued. It also recommends an Audit to be carried out, at most three years after commencement.

3.3.7 National Environment (Wetlands, Riverbanks and Lake Shores Management) Regulations, No.3 3/2000

The central or local governments shall hold in trust and protect wetlands, riverbanks and lakeshores for the common good of the citizens of Uganda.
Regulation 23 (1) A person who intends to carry out any of the following activities shall make an application to the executive Director in Form A set out in the First Schedule to these Regulations - (a) use, erect, reconstruct, place, alter, extend, remove or demolish any structure or part of any structure in, under, or over the riverbanks or lake shore;
Regulation 23 (1) The rivers specified in the sixth Schedule to these Regulations shall have a protection zone of one hundred meters from the highest watermark of the river. (2) Rivers not specified in the Sixth Schedule shall have a protected zone of thirty meters from the highest watermark of the river.

Relevance to this Project: Application for a permit to carry out a regulated activity in a wetland, riverbank of River Kiruruma from NEMA will be sought under this regulation.

3.3.8 Water Resources Regulations, 1998

License abstraction from lakes, rivers and groundwater stipulates that obtaining a license requires consideration of other uses, including those downstream.
Regulation (2) An application referred to under sub regulation (J) shall, (a) be in the form specified in the First Schedule to these regulations except that,
(i) Form A shall be used for surface water permits: and
(ii) Form B shall be used for groundwater permits;
Regulation (3) A person who wishes to construct any works for the purpose of, (a) impounding, damming, diverting, or conveying any surface water, whether or not on or adjacent to a waterway; or may apply to the Director for a construction permit in Form F1 of the Sixth Schedule.

Relevance to this Project: Application for surface water permits (Form A), construction of dam permit (Form under Part F and Form F1), will be sought under this regulation.

3.4 Institutional Framework

3.4.1 National Environment Management Authority (NEMA)

The National Environmental Act provides for the establishment of NEMA as the principal agency responsible for coordination, monitoring and supervision of environmental conservation activities. NEMA is under the Ministry of Water and Environment but has a cross-sectorial mandate to oversee the conduct of ESIA through issuance of ESIA guidelines, regulations, and registration of practitioners. It reviews and approves Environmental and Social Impact Statements (ESIS) in consultation with any relevant lead agencies. NEMA works with District Environment Offices and Local Environment Committees at local government level, which undertake inspection, monitoring, and compliance enforcement on its behalf.

Relevance to this Project: NEMA is the agency responsible for receiving, reviewing, consulting other lead agencies, approving, and awarding an ESIA certificate with conditions for this ESIS. It will also be in its mandate to make public the findings of this ESIA as well as making recommendations to address any environmental and social impacts as a result of the project implementation.

3.4.2 Ministry of Water and Environment

The Ministry of Water and Environment (MWE) is the lead agency for the provision and management of water supply and sanitation services in Uganda. The Ministry has the responsibility for setting national policies and standards, managing and regulating water resources and determining priorities for water development and management. It also monitors and evaluates sector development programmes to keep track of their performance, efficiency and effectiveness in service delivery. MWE has three directorates**:** Directorate of Water Resources Management (DWRM), **Directorate of Water Development (DWD)** and the Directorate of Environmental Affairs (DEA).

DWD bears 4 departments, including **Water for Production (WfP) Department** which bears a major objective of promoting development of cost-effective and sustainable water supply and water management for increased production and contribution to the modernization of the agricultural sector in Uganda with a focus on poverty reduction and minimal environmental impacts through:

- Bulk water transfers from areas of plenty to areas of scarcity.
- Promoting water resources assessment and planning for agricultural production.

- Increasing the capacity of the farmers to access and use of water for crop, livestock and fisheries production.
- Promoting appropriate water harvesting technologies for irrigation and livestock development.
- Promoting the participation of the farmers and the private sector in financing and planning, development and management of irrigation and livestock water supply systems.
- Provision of technical support to Line Ministries and Local Government.

DWRM is responsible for managing and developing water resources of Uganda in an integrated and sustainable manner in order to provide water of adequate quantity and quality for all social and economic needs for the present and future generations. The Directorate comprises of five departments namely Water Resources Monitoring and Assessment Department, **Water Resources Planning and Regulation Department**, Water Quality Management Department, water management zones and the International Transboundary and Water Affairs Department.

Relevance to this project: This project has been conceptualized, designed and will be implemented under Directorate of Water Development (DWD), Water for Production Department (as the developer). Directorate of Water Resources Management (DWRM), and Water Resources Planning and Regulation Department was also identified as a major stakeholder since it's the issuing institution for both construction license and surface water abstraction permits that will have to be sought by the scheme.

3.4.3 Ministry of Gender, Labour and Social Development (MGLSD)

MGLSD is the leading and coordinating agency for the Social Development Sector. In collaboration with other stakeholders, MGLSD is responsible for occupational safety, labour productivity and employment, gender equality & equity, human rights, culture and empowerment, and obligations of tee specified vulnerable groups for social protection and gender responsive development. Overall, the Ministry aims to achieve a better standard of living, equity and social cohesion through five directorates; Social Protection; Labour, Employment, Occupational; Safety and Health; Gender and Community; and Development. These are tasked to;

(i) Promote decent employment opportunities and labour productivity.
(ii) Enhance effective participation of communities in the development process.
(iii) Enhance the resilience and productive capacity of the vulnerable persons for inclusive growth.
(iv) Empower youth to harness their potential and increase self-employment, productivity, and competitiveness.
(v) Promote rights, gender equality & equity and women empowerment in the development process.
(vi) Strengthen the performance of the Social Development Sector (SDS) institutions; and
(vii) Redress imbalances and promote equal opportunity for all.

Relevance to this Project:

*During Scoping stage, the following MGLSD directorates (*Table 2-16*) were identified as key stakeholders for the project and were consulted under the study.*

Table 3-1: Relevance of key MGLSD directorates

Directorate	Department	Relevance
Safety and Health	Occupational, Health and Safety (OHS)	*Issues a work registration permit for the scheme construction site and also captures OHS issues in scheme related safeguards.*
Gender and Community	Gender and Women Affairs	*Guide in design of gender inclusive safeguards for the scheme.*
	Community Affairs	*Guide in identification of scheme social risks and safeguards.*
	Family and Culture Affairs	*Guide on how to include the Batwa on the scheme.*

3.4.4 Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)

Overall, the Ministry aims to create an enabling environment in the Agricultural Sector through four directorates, including Directorate of; Crop Resources; Animal Resources; Fisheries Resources; and Agricultural extension services. These are tasked:

i) To initiate the formulation and review of the policy and legal framework for the sector.
ii) To establish and implement systems for service provision in the sector.
iii) To strengthen and implement strategies, regulatory framework, standards, institutional structures and infrastructure for quality assurance and increased quantities of agricultural products to access and sustain local, regional and export markets.
iv) To design and implement sustainable capacity building programmes for stakeholders in the agricultural sector through training, re-tooling, infrastructure, provision of logistics and ICT.
v) To develop strategies for sustainable food security.
vi) To develop appropriate agricultural technologies for improved agricultural production, productivity, and value addition through research.
vii) To develop effective collaborative mechanisms with affiliated institutions and
viii) To take lead and establish a system and institutional framework for agricultural data collection, analyses, storage and dissemination to stakeholders including Uganda Bureau of Statistics.

Relevance to this project: Directorate of Crop Resources will support sustainable, market-oriented crop production, pest and disease control, quality and safety of plants and plant products; for improved food security and household income under the scheme command area. Whereas, Department of Agricultural Infrastructure, Mechanization and Water for Agricultural Production (DAIMWAP), will guide in review of scheme designs in response to support of development of agricultural infrastructure, and use of water for

agricultural production along crops. Engagement of this ministry under the study was mainly for inclusion guided achievement of project objectives of increasing productivity and farmers' resilience to climate change, through prioritized development of irrigated agriculture.

3.4.5 Ministry of Tourism, Wildlife and Antiquities

The Ministry of Tourism, Wildlife and Antiquities is a Government Ministry with a responsibility to sustain tourism, wildlife and cultural heritage. This is aimed at contributing to transforming Uganda into a prosperous country. The Ministry of Tourism, Wildlife and Antiquities is mandated to Formulate and implement Policies of Tourism, Wildlife and Cultural Heritage, Sustain and manage wildlife and cultural heritage conservation areas, Diversify Tourism Product as well as Promoting and marketing Uganda as a preferred tourism destination. The ministry will be informed immediately if any chance find takes place during excavations.

3.4.6 The World Bank

The World Bank as a funding agency shall provide overall technical guidance in the implementation of the project in regard to the financing agreement, proper documentation of the ESIA, inclusion of ESIA recommendations in the procurement documents and contracts as well as enforcement of safeguards in accordance with the World Bank and Uganda country safeguards system, particularly in terms of dam safety. The responsible World Bank team shall undertake implementation support missions, orientation of implementation teams, safeguards and support the Ministry's capacity in monitoring and reporting requirements.

3.4.7 Local Administration Structures

The proposed scheme falls within the jurisdiction of Kanungu District. A district is headed by a Chairman Local Council Five (LC5) who is the political head and Chief Administration Officer, the technical head of district administration. Technical District personnel directly involved with the project includes Environmental Officer, District Planner, Community Development Officer, District Director of Health Services, Wetlands Officer, Forestry Sector Manager, Agricultural Officer, District Water Officer, and District Engineer.

Relevance to this Project: Kanungu Local administration government will bear the responsibility for monitoring and evaluating performance of proposed scheme implementation against the ESMMP. Notwithstanding also the responsibility for ensuring compliance to the relevant laws including those relating to welfare, social and

environmental protection. Specifically, the technical division personnel directly involved with the project include;

i. *Engineer; inspect the construction works as per the contract.*
ii. *Water Officer/ Engineers; Technical advice on irrigation water issues and inspection of scheme infrastructural works.*
iii. *Agricultural Officer/ Senior Agricultural Engineer; Supervising and managing the agricultural sub sector activities; Training and development programmes for farmers on production methods, technologies, water and soils conservation, agricultural engineering, water harvesting and irrigation, and proper land use; Compilation and dissemination of Agricultural information, data and statistics; Technical advice on the use of chemicals and pesticides.*
iv. *Environmental Officer; inspect the project sites and monitor the NEMA Project conditions including those of other auxiliary activities like workers camp site. Also monitor project ESMMP and ascertain the environmental and health practices/ conformity.*
v. *Community Development Officer; help in mobilization of the various stakeholders at the Division level and the LC1 which in turn will mobilize the community members for sensitization incentives (OHS, HIV, water usage, agriculture and others).*
vi. *Grievance focal person; receives and registers all grievances, presents them to the grievance committee which in turn addresses them to the responsible departments.*
vii. *Health Officer; inspect the project medical facilities at workers camp site and monitor and audit the contractor's Occupation, Safety & Health Management Plan.*
viii. *Labour Officer; Inspects the project site, as per the working conditions environment, checks for workers contracts and appointments, workers grievances and contractor's employment mechanism.*

3.5 Review of International guidelines, safeguards and documents

3.5.1 The World Bank Operational Policies

The World Bank being the financer, its Operational Policies (OP) on environmental and social safeguards were referenced as per project planning, implementation on grounds of best practices for the success of the project. The objective of the World Bank's environmental and social safeguards is to prevent and mitigate undue harm to people and their environment during the development process. These policies provide guidelines for Bank and Borrower staff in the identification, preparation, and implementation of programs and projects. Safeguard policies provide a platform for the participation of stakeholders in project design and are an important instrument for building ownership among local populations (World Bank, 2006). Table 3-2 presents the triggered World Bank policies.

Table 3-2 Identified project triggered World Bank Operational Policies

Triggered WB OPs	Description/ Relevance
OP 4.01, Environmental Assessment	This policy states that all projects proposed for WB financing require an environmental assessment to ensure that they are environmentally and socially sound and sustainable and support integration of environmental and social aspects of projects into the decision-making process. The Policy requires all WB projects to be categorized as 'A', 'B', 'C' or 'IF' depending on the potential project impacts. A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect the area broader than the sites or facilities subject to physical works. The Environmental Assessment for a project in this category examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives including the 'without project' situation, and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve an environmental performance. *In its WB/OPCS Guidelines for Environmental Screening and Classification 2007 World Bank provided an indicative list of Category A projects and listed "Large-scale agriculture, irrigation, drainage and flood control, aquaculture: agro industries, and production forestry" as Category A projects.* ***The policy was triggered*** *because the project will involve construction of irrigation infrastructure, storage reservoirs on River Kiruruma to enhance large scale irrigation of over 4420 ha hence, a need for conducting this Environmental and Social Impact Assessment.* ***Required policy action undertaken by the project:*** *An Environmental and Social Impact Assessment has been undertaken by the Proponent to identify the main environmental and social risks and impacts of the project and the necessary mitigation measures.*
OP 4.04 Natural Habitats.	The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The World Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The World Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. This policy was triggered by the presence of remnant natural forests along river courses (River Kiruruma) that connect to other bigger rivers (River Ntungwe) within the Queen Elizabeth National Park.
OP 4.36, Forests	The objective of this policy is to help borrowers exploit the potential of forests in order to curb poverty in a sustainable manner, efficiently integrate forests in sustainable economic development and protect vital local and global environmental services and forest values. Where forest restoration and plantations are needed in order to achieve these objectives, the Bank helps borrowers in forest restoration activities in order to maintain or develop biodiversity and the operation of ecosystems. The Bank helps borrowers in the creation of forest plantations appropriate from the environmental viewpoint and socially beneficial and economically sound in order to help meet the growing forests' needs and services. ***The policy was triggered*** *because in view of the project induced potential impacts to the Queen Elizabeth National Park (QENP) biosphere reserve (downstream of the command area).* ***Required policy action undertaken by the project:*** *Downstream ecosystem baseline has been recorded and mitigation measures included.*

Triggered WB OPs	Description/ Relevance
OP 4.10, Indigenous Peoples	This policy affirms WB's commitment to protect indigenous people. This Policy therefore requires for Borrowers and Bank staff to identify indigenous peoples, consult with them, ensure that they participate in, and benefit from Bank-funded operations in a culturally appropriate way - and that adverse impacts on them are avoided, or where not feasible, minimized or mitigated. The policy recognizes that "the distinct identities and cultures of Vulnerable and Marginalized Groups (VMGs) remained inextricably linked to the lands they inhabited and the natural resources they depended upon to survive". The policy requires that: (i) screening, (ii) social assessment, consultations with communities involved, (iii) preparation of a Vulnerable and Marginalized Groups Framework (VMGF) and, (iv) disclosure be carried out before the project is implemented. It also requires the Borrower to seek broad community support of VMGs through a process of free, prior, and informed consent before deciding to develop any project that targets or affects VMGs. ***The policy was triggered*** *because of presence of Batwa also known as Twa or Pigmies who live primarily in south-western Uganda, identified as a Vulnerable and Marginalized Group (VMG) according to the World Bank's OP 4.10.* ***Required policy action undertaken by the project:*** *A Vulnerable and Marginalized Groups' Framework (VMGF) was prepared (Appendix F) aimed at avoiding adverse impacts on VMGs and to provide them with culturally appropriate and gender sensitive benefits; and guarantee the full participation of VMGs in the entire scheme cycle. It prompted identification of all Vulnerable and Marginalized Groups (VMGs) in the area through ESIA-social-cultural baseline studies in the project area and consultation with the Batwa.* The policy mandates that special attention must be given to the vulnerable groups ie The Batwa to ensure that they do not suffer disporopportionately due to loss of livelihoods. The main requirements for addressing the needs of vulnerable people under OP 4.12 include: 1. consultation and participation: The Batwa were consulted during planning process to ensure that their concerns and needs are addressed. 2. Livelihood restoration: For Vulnerable persons, the policy emphasizes measures to improve, or at least resore their income earning opportunities and access to basic services. 3. Monitoring and Support: Special monitoring mechanisms shall be established to ensure that vulnerable groups are adequately supported throught out the resettlement process and after project completion. During the implementation of Matanda Dam, MWE will implement support programs targeting the Batwa during and after construction of Matanda Dam.
OP 4.09, Pest Management	The policy aims at minimizing and managing the environmental and health risks associated with pesticide use and promoting and supporting safe, effective, and environmentally sound pest management. ***The policy was triggered*** *because the project is aimed at boosting agricultural production and income at household level amidst climatic variability which is one of the factors leading to proliferation of crop and livestock pests and diseases whose control will likely require use of pesticides and agro-chemicals.* ***Required policy action undertaken by the project:*** *An Integrated Pest Management Plan (IPMP) has been prepared as part of this ESIA. It benchmarks the requirement to conduct*

Triggered WB OPs	Description/ Relevance
	pesticide use baseline in the command area and guides on development and integration of demand driven, ecologically based biological or integrated pest management practices conforming to United Nations Food and Agriculture Organization (FAO) Pesticide Guidelines in the project ESMMP.
OP 4.11, Physical Cultural Resources	This policy aims to assist in preserving Physical Cultural Resources (PCRs) and avoiding their destruction or damage. PCRs include resources of archaeological, paleontological, historical, architectural, and religious (including graveyards and burial sites), aesthetic, or other cultural significance. ***The policy was triggered*** *because the project will involve extensive excavations which may accidentally unearth or expose buried artefacts, i.e., chance finds.* ***Required policy action undertaken by the project:*** *A Chance Find Procedure has been prepared as part of this ESIA to provide guidance on PCR handling and management.*
OP 4.12, Involuntary Resettlement	The policy aims at avoiding or minimizing involuntary resettlement and, where this is not feasible, to assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. This policy is applied wherever land, housing or other resources are taken involuntarily from people. It sets out the objectives to be met and procedures to be followed for carrying out baseline studies, impact analyses, and mitigation plans when affected people move or lose part of their livelihoods. ***The policy was triggered*** *because project works (involving construction of common project infrastructure such as; dam sites, irrigation channels, irrigation infrastructures) will necessitate land take triggering compensation and resettlement of Project Affected Persons (PAPs). Accordingly, a RAP has been prepared alongside this ESIA report.* ***Required policy action undertaken by the project*** *A Resettlement Action Plan (RAP) has been prepared alongside this ESIA report. The RAP will be implemented sectionally ie Dam, Main Pipe line, and tertiary and secondary network before commencement of any construction works.*
OP 4.37, Safety of Dams	The policy aims at assuring quality and safety in the design and construction of new dams and in carrying out activities that may be affected by an existing dam. ***The policy was triggered*** *due to proposed construction of a large dam (31.14 m) whose design and management plans have been reviewed by an independent panel of experts.* ***Required policy action undertaken by the project:*** *Dam Safety Management and Emergency Plans namely; Construction Supervision and Quality Assurance Plan (CSQAP), Instrumentation Plan (IP), Operation and Maintenance Plan (O&MP) and Emergency Preparedness Plan (EEP) have been prepared for the Matanda dam scheme alongside the ESIA to provide guidance on dam management in the event of failure. Government of Uganda has a dam safety panel in place, established under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and NCORE funded by the World Bank.*
OP 7.50, Projects on International waters	This policy applies to the following types of international waterways:(a) any river, canal, lake, or similar body of water that forms a boundary between, or any river or body of surface water that flows through, two or more states, whether Bank members or not. The same policy applies to the following types of projects: (a) hydroelectric, irrigation, flood control, navigation, drainage, water and sewerage, industrial, and similar projects that involve the use or potential pollution of

Triggered WB OPs	Description/ Relevance
	international waterways. The policy ensures that the international aspects of a project on an international waterway are dealt with by notifying the other riparians of the proposed project. ***The policy was triggered*** *because the project is hosted by R. Kiruruma, which drains into R. Kagera, which is a transboundary river.* ***Required policy action undertaken by the project****: Riparian notification has been undertaken by GoU through the Nile Basin Initiative on November 13, 2018. Only Tanzania responded to give no objection, while the rest of the countries did not respond. The following Riparian States were notified: Burundi, DR-Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, and Tanzania.*

3.5.2 World Bank Group Environmental, Health, and Safety General Guidelines

The Environmental, Health, and Safety (EHS) Guidelines of the World Bank Group (WBG) are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). Effective management of environmental, health, and safety (EHS) issues entails the inclusion of EHS considerations into corporate and facility-level business processes in an organized, hierarchical approach that includes mechanisms for identifying EHS project hazards and associated risks as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans.

A. Environmental, Health, and Safety Guidelines for Construction Materials Extraction

This document includes information relevant to construction materials extraction activities such as aggregates, limestone, sand, gravel, and clay amongst others. It addresses stand-alone projects and extraction activities supporting construction, civil works, and cement projects. Although the construction materials extraction guidelines emphasize major and complex extraction schemes, the concepts are also applicable to small operations.

Some of the key concepts covered under these Guidelines include:

- *Environment:* Environmental issues during the operational, construction, and decommissioning phases of construction materials extraction primarily include aspects such as air emissions, noise and vibrations, water, waste, and land conversion.
- *Occupational Health and Safety:* OHS hazards likely to occur during the operational phase of construction materials extraction projects which primarily include respiratory hazards, noise, and physical hazards; and
- *Community Health and Safety:* Issues relating to construction, operation, and decommissioning mainly focus on land instability, water and explosives safety and aspects of decommissioning at the end of the project.

Relevance to this Project: These were considered during the preparation of this ESIA with the objective of ensuring project compliance with these provisions. Accordingly, an ESMMP has been prepared to address anticipated negative environmental and social impacts during the project implementation phase. The guidelines will also be benchmarked during material extraction and relevant assessment studies for borrow pits or quarry sites for the proposed project. However, during quarry activities, the contractor will before blasting undertake a thorough risk assessment to identify potential hazrds to workers, communities, and the environment. A detailed blasting plan will be prepared that outlines the timing, methods and safety precautions and also accounts for environmental impacts such as vibrations, noise and dust as well as obtaining all relevant permits and approvals from regulatory bodies before conducting any blating activities.

B. World Bank Group EHS General Guidelines

The World Bank Group EHS General Guidelines (Table 2-18), dated April 2007, contains the performance levels and measures generally considered to be achievable at reasonable costs by existing technology. The EHS General Guidelines is a technical reference document with general and industry-specific examples of Good International Industry Practice**.** The following EHS Guidelines have been considered in the development of this ESIA:

The applicable industry sector guidelines for this project include:

- EHS Guideline on Water and Sanitation of 2007. The guidelines provide technical reference material on internationally accepted practice for water development and treatment activities in regard to Environment, Occupational & Community Health and Safety;
- EHS Guideline on Hazardous Materials Management, 2007
- Good Practice Handbook for Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, 2013; and
- EHS General Guidelines, 2007, including but not limited to Occupational & Community Health and Safety (see Table 2-18):

Table 2-18: Organization of General EHS Guidelines

General EHS Guidelines	Applicability
Environmental	
Air Emissions and Ambient Air Quality	WHO Ambient Air Quality Guidelines will be referenced during monitoring of construction activity generated air emissions/dust visa via the draft National Air Quality Standards, 2006
Energy Conservation	These guidelines apply to projects that consume energy in process heating and cooling; process and auxiliary systems, such as motors, pumps, and fans; ventilation and air conditioning systems (HVAC); and lighting systems. Mainly at the construction camp site and construction equipment.
Wastewater and Ambient Water Quality, Water Conservation	Will guide development of a water quality monitoring program for the sited wetlands along the proposed route. This will be enforced through acquisition of a Water Abstraction Permit from DWRM.

General EHS Guidelines	Applicability
Hazardous Materials Management	These guidelines apply to projects that use, store, or handle any quantity of hazardous materials, such as flammable liquids (fuel) and used oils. These will guide the contractor in development of oil spill contingency plan and acquisition of a Storage of Hazardous License from NEMA.
Waste Management	These guidelines apply to projects that generate, store, or handle any quantity of waste such as anticipated waste from workers camps, equipment yards and road construction sites. The guidelines call for waste management to be addressed through a waste management system that addresses issues linked to waste minimization, generation, reuse, recycling, transport, disposal, and monitoring, hence the need for a contractors Waste Management Plan.
Noise	Noise Level Guidelines will be referenced during monitoring of construction activity generated noise visa via the National Environment (Noise Standards and Control) Regulations, 2003.
Contaminated Land	These guidelines provide management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil from the construction project. These will guide the contractor in development of oil spill contingency plan and acquisition of a Storage of Hazardous License from NEMA.
Occupational Health and Safety	
General Facility Design and Operation	These guidelines call for integration of appropriate protection against the climate and have acceptable light and noise conditions for structure safety such as the camp site, dam.
Communication and Training	These guidelines call for OHS Training, Visitor Orientation, New Task Employee and Contractor Training, Communication of Hazard Codes, and Area Signage to be included in the Occupational Health and Safety Management Plan for the project.
Physical Hazards	Physical hazards represent potential for accident or injury or illness due to repetitive exposure to construction mechanical action or work activity. Occupational Health and Safety Management Plan for the project will have to have a procedure for identification, assessment, mitigation, and monitoring of project related physical hazards such as from Rotating and Moving Equipment, Noise, Vibration, Welding Work, etc.
Chemical Hazards	Chemical hazards represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. Occupational Health and Safety Management Plan for the project will have to follow the hierarchical approach in preventing chemical hazards.
Biological Hazards	Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure. These guidelines call for the project to have a preparedness and response plan for various diseases, mainly related to sanitization and other contagious diseases such as COVID19.

General EHS Guidelines	Applicability
Personal Protective Equipment	These guidelines will be referred to in acquisition of recommended Personal Protective Equipment (PPE) according to hazard.
Monitoring	These guidelines call for project Occupational Health and Safety monitoring programs that verify the effectiveness of prevention and control strategies with selected indicators representative of the most significant OHS hazards.
Community Health and Safety	
Water Quality and Availability	Drinking water sources shall at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality.
Structural Safety and Project Infrastructure	The guidelines were adopted during the design phase; Dam structural design, Irrigation network design layout and site modifications aimed at reduction of potential hazards. They will also guide in development of Occupational Health and Safety Management Plan and Dam Safety Management and Emergency Plans for the project with consideration of hazards posed to the public while accessing project site.
Life and Fire Safety	The guidelines call for the project campsite buildings to be designed, constructed, and operated in full compliance with local building codes and in accordance with an internationally accepted life and fire safety standard. They will also guide in development of Emergency Response and Preparedness Plan for the project with consideration of fire hazards.
Traffic Safety	The guidelines call for promotion of traffic safety by all project personnel during displacement to and from the workplace, and during operation of project equipment on private or public roads. They will also guide in the development of the Traffic Management Plan.
Transport of Hazardous Materials	The guidelines call for projects to have procedures in place that ensure compliance with local laws and international requirements applicable to the transport of hazardous materials. It is therefore imperative that the contractor procures services of a NEMA registered hazardous waste handler to undertake Collection, transportation and disposal of any project generated hazardous waste, such as used oils.
Disease Prevention	The guidelines recommended preventive interventions for communicable diseases, such as STIs (HIV/AIDs) and vector-borne disease that will be integrated at the project level through various plans, such as; HIV and other STIs Prevention and Management Plan, COVID19 preparedness and response plan.
Emergency Preparedness and Response	The guidelines recommend the project to bear an Emergency Preparedness and Response Plan that is commensurate with the risks of the project activities and that includes the following basic elements; Administration, Organization of emergency areas, Roles and responsibilities, Communication systems,

General EHS Guidelines	Applicability
	Emergency response procedures, Emergency resources, Training and updating, Checklists, Business Continuity and Contingency.
Construction and Decommissioning	
Environment	The guidelines provide additional, specific guidance on prevention and control of project impacts on the environment such as Noise and Vibration, Soil erosion, Air Quality, Solid Waste that may occur at the end of the project life-cycle.
Occupational Health and Safety	The guidelines provide additional, specific guidance on prevention and control of Occupational Health and Safety related impact such as Over-exertion, and ergonomic injuries and illnesses, Slips and Falls, Work in Heights, Moving Machinery, dust that may occur at the end of the project life-cycle.
Community Health and Safety	The guidelines recommend that the project shall implement risk management strategies, such; Disease prevention and Traffic safety as to protect the community from physical, chemical, or other hazards associated with sites under construction and decommissioning.

C. IFC and World Bank Social and Stakeholder Engagement Guidelines

In addition to the above, IFC and World Bank offer several good practice handbooks, including on social issues and stakeholder engagement, which will be consulted:

- 2009 IFC and EBRD Guidance Note on Workers' Accommodation: Processes and Standards
- 2009 Handbook for Addressing Project-Induced In-Migration
- 2010 Strategic Community Investment: A Good Practice Handbook for Companies Doing Business in Emerging Markets
- 2002 Handbook for Preparing a Resettlement Action Plan
- 2007 Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets
- 2009 Good Practice Note Addressing Grievances from Project-Affected Communities
- 2009 Addressing Project Impacts on Fishing-Based Livelihoods
- 2009 Introduction to Health Impact Assessment
- 2009 World Bank Guidance Note Mainstreaming Gender into Extractive Industries Projects
- 2006 Non-Discrimination and Equal Opportunity.

D. World Health Organization (WHO) Guidelines

- WHO Guidelines for Community Noise (1999).
- WHO Guidelines for Drinking water quality/ 4th Edition 1st Addendum 2017. The guidelines consider drinking-water safety, including minimum procedures and specific guideline values and how these are intended to be used. The Guidelines are recognized as representing the position of the UN system on issues of drinking-water quality and health and provide for parameter specific evaluation of water quality for elements not represented in the UNBS EAS 2014 standard for potable water.
- World Health Organisation Global Air Quality Guidelines (2005).

Table 3-3 Recommended WHO 2021 AQG level and 2005 air quality guidelines

Pollutant	Units	Averaging time	2021 AQG level	2005 air quality guideline
Sulfur dioxide (SO_2)	µg/m^3	24hr mean[1]	40	20
Nitrogen Dioxide (NO_2)	µg/m^3	1-Year	10	40
		24-hour3	25	-
Particulate matter (PM10)	µg/m^3	1-year	15	20
		24 - hour3	45	50
Particulate matter (PM2.5)	µg/m^3	1- year	5	10
	µg/m^3	24 - hour3	15	25
Ozone (O3)	µg/m^3	Peak season [2]	60	-
		8-hour daily maximum3	100	100
Carbon monoxide (CO)	mg/m^3	24-hour3	4	-
AQG denotes Air Quality Guideline				

E. Environmental, Health, and Safety Guidelines Water and Sanitation

The EHS Guidelines for Water and Sanitation include information relevant to the operation and maintenance of potable water treatment and distribution systems.

3.5.3 Relevant international conventions and agreements

Uganda is a signatory to a number of international agreements and conventions relating to the environment both at regional and global level which are relevant to supporting the national efforts in environmental management and the welfare of communities. They are relevant to the construction sector / efforts provided they support or are in consonance with the applicable Laws and Regulations in Uganda. The sections below describe some of these agreements/conventions, including:

(i) Convention on Protection and Use of Transboundary Watercourses and International Lakes 1992

Under Article 1, The Parties shall take all appropriate measures to prevent, control and reduce any transboundary impact on the watercourses and the Parties are obliged to: prevent, control and reduce pollution of waters causing or likely to cause transboundary impact; ensure that transboundary waters are used with the aim of ecologically sound and rational water management, conservation of water resources and environmental protection; ensure that transboundary waters are used in a reasonable and equitable way, taking into particular account their transboundary character, in the case of activities which cause or are likely to cause transboundary impact; ensure conservation and, where necessary, restoration of ecosystems; and Measures for the prevention, control and reduction of water pollution shall be taken, where possible, at

[1] 99th percentile (i.e., 3-4 exceedance days per day)

[2] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six month running-average O_3 concentration

source. *In the implementation of the project, GoU Uganda is preparing the ESIA to ensure that the project does not cause significant impacts to the Transboundary waters.*

(ii) Guidelines of the World Commission of Dams (WCD)

WCD was created by the World Bank and IUCN in May 1998 in response to growing opposition to large dams. The International Commission on Large Dams (ICOLD) defines a large dam as one with a height of 15 m or more from the foundation. If dams are between 5-15 m high and have a reservoir of more than 3 million cubic meters, they are also classified as large dams. *It is noted that, Matanda Irrigation Scheme is a category A type as such, it will have a large dam (project dam height is 31.14 m) as such facilities link the development to WCD, the WCD recommendations will be applicable in its implementation.*

(iii) Convention of Biological Diversity

The Convention on Biological Diversity (CBD), known informally as the Biodiversity Convention, is a multilateral treaty. The Convention has three main goals namely conservation of biological diversity (or biodiversity); sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources. In other words, its objective is to develop national strategies for the conservation and sustainable use of biological diversity. It is often seen as the key document regarding sustainable development. *Uganda is a signatory to this convention and when the ESIA is being undertaken for this project, there shall be recommendations that the proponent will abide by the convention requirements to carry out assessments for all projects likely to have significant adverse effects on biodiversity. This project is in line with the spirit of the convention, there is a need to integrate biodiversity in water resource planning as the environment has been considered a legitimate user of water thus the project shall consider the volume of water abstracted leaves enough water for the existent ecosystems.*

(iv) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973

Uganda is a signatory to this treaty, which outlines the role of all parties to protect endangered plants and animals. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild, and it accords varying degrees of protection to more than 35,000 species of animals and plants. No animals will be traded in the course of the planned project implementation and all its phases. The workers will be briefed on risks of engaging in animal hunting and trade.

(v) Convention on the Conservation of Migratory Species of Wild Animals

The convention aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. The project will in its implementation be cognizant of migratory aspects of wildlife some through its areas of implementation and such wildlife will not be hunted.

(vi) Ramsar Convention on Wetlands, 1971

Is an international treaty for the conservation and sustainable utilization of wetlands, to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. The implementation of the proposed project is to take into account the need for sustainable management of wetlands and ensure that the wetland areas within the project area are conserved.

(vii) Strategic Approach to International Chemicals Management (SAICM)

Uganda UNEP/UNDP Partnership initiative for the implementation of SAICM is intended to assist the Government, through the National Environmental Management Authority (NEMA), to take up the strategic priorities of SAICM Quick Start Program (SQSP), namely: develop and strength national chemicals management institutions, plans, programs and activities to implement the Strategic Approach, building upon work conducted to implement international chemicals-related initiatives; and undertake analysis, interagency coordination, and public participation activities directed at enabling the implementation of Strategic Approach by integrating the sound management of chemicals in national development priorities and strategies. *Provisions of SAICM will be considered in the project by developing IPMP for the project to ensure information, capacity building and general safe handling of agrochemicals.*

(viii) UNESCO World Heritage Convention, 1972

In the International arena, the legal regime regarding Cultural Heritage basically emanates from the UNESCO World Heritage Convention, 1972. The convention is concerned with the protection of the World Cultural and Natural Heritage. This convention gives the basis of recommendations developed by experts to conserve Cultural Heritage. *Uganda, the country within which this project is to be constructed, is a member of UNESCO and as such is bound by the recommendations made by the convention in the protection of Cultural Heritage, especially the chance findings on the project and the Batwa.*

(ix) The African Convention on the Conservation of Nature and Natural Resources, 1968

The contracting states to this Convention are required to undertake / to adopt measures to ensure conservation, utilization and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interest of the people. The States are also required to ensure that the conservation and management of natural resources are treated as an integral part of National and /or Regional Development Plans. *During the formulation of the ESMMP, full consideration was given to ecological, economic and social factors in the project area.*

(x) The Convention for the Safeguarding of the Intangible Cultural Heritage, 2003

The Convention calls on States that have ratified it to Safeguard Living Heritage on their own territories and in cooperation with others. It seeks to celebrate and safeguard the intangible heritage distinctive for particular communities. It affirms that the intangible heritage of all communities – whether they are large or small, dominant or non-dominant – deserve respect. The Convention defines "intangible Cultural heritage" as the practices, representations, expressions, knowledge, skills as well as the instruments, objects, artefacts and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their Cultural Heritage. This Intangible Cultural Heritage, transmitted from generation to generation,

is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity. *The Project therefore will be required not to disrupt the Living Heritage but will be expected to safeguard it so as to ensure that the heritage where it exists continues to be practiced and transmitted within the community or group concerned specifically the Batwa community (VMG). Communities shall be actively involved in the project life cycle to safeguard and manage their Living Heritage, since it is only them who can consolidate its present and ensure its future.*

(xi) The United Nations Framework Convention on Climate change (UNFCCC), 1992

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty negotiated at the Earth Summit in Rio de Janeiro from 3 to 14 June 1992, then entered into force on 21 March 1994. UNFCCC has 197 parties as of December 2015 of which Uganda is a member. Its sister Rio Conventions are the UN Convention on Biological Diversity and the Convention to Combat Desertification. Preventing "dangerous" human interference with the climate system is the ultimate aim of the UNFCCC. *Therefore, all project works, especially installation of the irrigation network in the 4420 Ha shall maintain the ecological integrity of the habitat by avoiding activities that could enhance climate change, especially massive tree cutting.*

(xii) The Stockholm Convention

The Convention seeks to protect human health and the environment from persistent organic pollutants (POPs). Uganda acceded to the Convention on 20th July 2004. Among the pollutants, controlled under the Convention are unintentionally released persistent organic pollutants. The National Implementation Plan (NIP) developed under the Convention in December 2008, to eliminate and minimize the impacts of (twelve) 12 of the most harmful hazardous chemicals in the world, identifies over 70% of the unintentionally released POPs to be a result of uncontrolled open burning of waste. The Plan, therefore, recommends reduction of unintentionally released POPs through emission at source by promoting cleaner production methods and Best Available Techniques and Best Environmental Practices. *Management of waste under the project will have to be undertaken in line with this requirement by avoiding burning of waste, among others.*

(xiii) Convention on Elimination of All Forms of Discrimination against Women

The Convention on the Elimination of all Forms of Discrimination against Women is an international treaty adopted in 1979 by the United Nations General Assembly. Described as an international bill of rights for women, it was instituted on 3 September 1981 and has been ratified by 189 states including Uganda. Article 1 defines discrimination against women as; any distinction, exclusion or restriction made on the basis of sex which has the effect or purpose of impairing or nullifying the recognition, enjoyment or exercise by women, irrespective of their marital status, on a basis of equality of men and women, of human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field. *Therefore, all forms of discrimination against women during implementation of the project activities shall be condemned. A gender management plan developed is requested by the contractor.*

(xiv) Convention on Protection of Migrant Workers

The International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families is a United Nations multilateral treaty governing the protection of migrant workers and families. Signed on 18 December 1990, it entered into force on 1 July 2003 after the threshold of 20 ratifying States was reached in March 2003. The Committee on Migrant Workers monitors implementation of the convention and is one of the seven UN-linked human rights treaty bodies. *Implementing contractors of this project may have foreign workers whose rights need to be protected.*

Foregoing notwithstanding, the contractor will have a contractual obligation to avoid impacts that may violate above conventions, wherever encountered during the project's implementation.

3.6 Analysis of the gap between the World Bank and National Safeguards Requirements

3.6.1 National Legal Framework

At the time of inception, scoping, development of the Terms of Reference (ToRs) of this project ESIA, submission of the scoping report and ToRs to NEMA (1st August, 2019) and approval (5038- 26.08.2019), the National Environment Act, Cap 153-1995 was still in force. The project was classified under Third Schedule of this Act, section (4): Dams, rivers and water resources, in both sub section (a): storage dams, barrages and weirs and sub section (b): river diversions and water transfers between catchments, to which the proposed project was qualified for detailed ESIA.

However, by the end of 2019, the National Environmental Act, no 5 of 2019 repealed, replaced and reformed the National Environment Act (NEA), Cap 153-1995. The new Act classified the project to require a detailed ESIA under Schedule Five basing on two categories, including; *Category 4*: Utilization of water resources and water supply; (a) Abstraction or utilization of surface water for agricultural, industrial or urban use of more than 21.709 MCM. The Matanda scheme is planned to abstract 21.709 MCM. (c) Diversion of water from a river or stream, where the water discharged is more than 400 m^3/day or 30% of Internal Renewable Water Resources over the river catchment. Matanda scheme is planned to divert 21.709 MCM from River Kiruruma; Category 6: Agricultural investments, livestock, range management and fisheries; (d) large scale irrigation of more than 20 hectares. The command area of the scheme is 9000 Ha.

3.7 Acquisition of Requisite Permits for the Project

Implementation of the project will require the acquisition of necessary permits and licenses (Table 3-4) in line with the laws of Uganda.

Table 3-4: Permits and licenses expected to be required by the project

Permit Required	Issuing Authority	Legal Framework	Relevance	Responsible for obtaining permit
Project NEMA approval certificate	NEMA	National Environment Management Act, 2019	Environmental and Social Impact Assessment for Matanda Irrigation Scheme in Kanungu District.	MWE
Workplace registration	MGLSD/OHS	OHS Act, 2006	The scheme designs and activities on site must comply with Occupational Health and Safety standards for the benefit of the community. Construction equipment will have to be inspected.	Contractor
Waste Transportation License	NEMA	National Environment Act 2019; National Environment (Waste Management) Regulation	Under project waste management, Hazardous waste will have to be sorted, collected, and transported off site for disposal.	Contractor
River Dredging Permit	DWRM	Rivers Act, cap 357	A given river section will be dredged during erection of a coffer dam and construction of the water abstraction dam for the scheme.	Contractor
Surface Water abstraction permit	DWRM	Water Resources Regulations, 1998	Water abstraction for both construction works and irrigating the command area from River Kiruruma.	Contractor
Construction works Permit	DWRM		At water abstraction, dams, spillways, and wires will have to be constructed in the water body.	Contractor
Riverbank use permit	NEMA	National Environment (Wetlands, Riverbanks and Lake Shores Management) Regulations, No.3 3/2000	Construction of the Dam, spillways, wires.	Contractor

3.8 Project agreements

On commencement of the project, various agreements (Table 2-21) are required to be filed and checked by the monitoring party.

Table 3-5: Agreements to be required by the project

Agreements Required	Acquiring party	Monitoring party
Lease/Rental agreement for the Camp site	Contractor	Supervising Consultant MWE NEMA
Lease agreement for the Borrow site	Contractor	
Memorandum of Understanding with NEMA registered hazardous waste handler	Contractor	
MoU with local health facility for referral of any serious accidents and illnesses that can't be handled by the site clinic	Contractor	
Memorandum of Understanding with domestic waste handler/ Municipal/ Kanungu District	Contractor	

METHODOLOGY

4 METHODOLOGY

This chapter describes the broad principles of the assessment methodology that was adopted for the environmental and social studies conducted for the proposed scheme. In doing so, it describes the approach that was used to identify, evaluate, and mitigate environmental and social impacts, and come up with an ESMMP for this project.

4.1 Kick-off meeting with the client

Immediately after signing of the contract, the consultant held a kick-off meeting with the client to ensure that both the client and consultant have a common understanding of the proposed study activities and deliverables. Aspects of discussion in this meeting included; the consultant's state of mobilization, work plans, strategy and methodology of assignment execution on an activity-by-activity basis, the personnel and their respective responsibilities and authority. From the meeting, both parties agreed that commencement of the ESIA requires preliminary design since different facilities/ infrastructure have different impacts. Initiation of the study early in the design would allow the design engineers to incorporate impact prevention or mitigation recommendations into the design as it progresses to the final stage. Additionally, this would help the designer in the consideration of options during the feasibility study stage. Additional field visits were conducted following the change in dam embankment location and extended command area (3rd to 6th March 2020 and October 2023).

4.2 Inception and Scoping

The consultant's major aim during the inception and scoping phases was to obtain an understanding of the proposed project components, existing conditions in the proposed irrigation scheme sites including the command area, location of intake, scheme, and proposed number of beneficiaries, existing water sources, land use, and area administration on the scheme. Specifically;

i) Identify key stakeholders and engage them for information that would inform ESIA terms of reference;
ii) Disclose project information to key stakeholders and interested parties.
iii) Determine an appropriate spatial and temporal scope for impact assessment;
iv) Identify suitable survey methodologies;
v) Identify key environmental and social issues;
vi) Undertake preliminary identification of likely impacts, and
vii) Develop terms of reference to guide environmental and social assessment studies of Matanda Irrigation scheme.

4.2.1 Site inception reconnaissance visit

A field reconnaissance of proposed Matanda irrigation scheme during inception was conducted on 1st November, 2018 as to familiarize with the project area.

Photo 4-1 Inception field reconnaissance of proposed Matanda irrigation scheme

A field visit during scoping was conducted between 5th and 8th February 2019 in the proposed Matanda/ Irrigation Schemes project areas.

Photo 4-2: Scoping field reconnaissance of proposed Matanda irrigation scheme

This scoping field visit enabled the team to partly verify the information obtained from the various stakeholders during the stakeholders' meetings, identification of any other project area attributes, and preliminary anticipated impacts associated with the irrigation project.

4.2.2 Preliminary study outcomes

After the inception field reconnaissance:

1) **Presentation of the initial inception findings;** a strategic initial inception presentation (Figure 4-3) was made by ESIA consultant (AWE) at the premises of World Bank on 14th November, 2018 to the Funder (World Bank Officials), Client (MWE) and design consultant (Aarvee Associates), highlighting findings from the inception field reconnaissance and proposed scoping methodologies.

2) **Inception Report preparation**; An inception report was drafted by the consultant and submitted to the client on 14th December, 2018 for review and comments from the Funder.

After the Scoping Exercise

3) **Presentation of the scoping exercise findings** was done by ESIA consultant (AWE) at the premises of World Bank on 22nd May, 2019 to the Funder (World Bank Officials), Client (MWE) and design consultant (Aarvee Associates), highlighting findings from the scoping exercise and the developed ToRs.

4) **Scoping report preparation**; a scoping report was drafted by the consultant and submitted to the client on 10th June, 2019 for review and comments from the Funder.

5) **Approval of ToRs;** The project scoping report and ToRs was submitted to NEMA on 1st August, 2019 and ESIA - ToRs were approved on 26th August, 2019 with guiding study conditions.

4.4 Zone of Influence (ZoI)

Environmental Change	ZoI Definition & Justification	Zone of Influence
E-Flow	ZoI is considered as that part of the river where the water abstraction for the purpose of irrigation scheme development could affect the ecological functioning of the river if mitigation measures were not appropriately implemented.	Rivers downstream of the abstraction point to that point when substantial flows would be added to the river system. Specifically, the river section between the proposed abstraction points and the point of confluence of R. Kiruruma, R. Rushaya and R. Mitano.
Land Take, Land Cover change	Land-take/land cover change will only take place in areas where construction / decommissioning is planned.	Command area
Ecological and aquatic	The geographical area and the ecological features within it which have the potential to be impacted by the Project.	Dam site + Command area + 1 km offset from Command area
Fauna, Flora, social, pollution	The geographical area within which views of the construction and operational phases of the Project could potentially be possible. Project's AoI as described in section 5.3.2.	Dam site + Command area + 1 km offset from Command area
Cumulative impacts	The overarching spatial scope of the Cumulative impacts is based on the Project's Area of Influence (AoI) as described in section 5.3.1 and 5.3 and in the neighbouring districts of Rukungiri and Kasese as described in Table 7.3	Kanungu District
Social Impacts	Administrative boundaries of the project area	Dam site sub-counties Command area villages

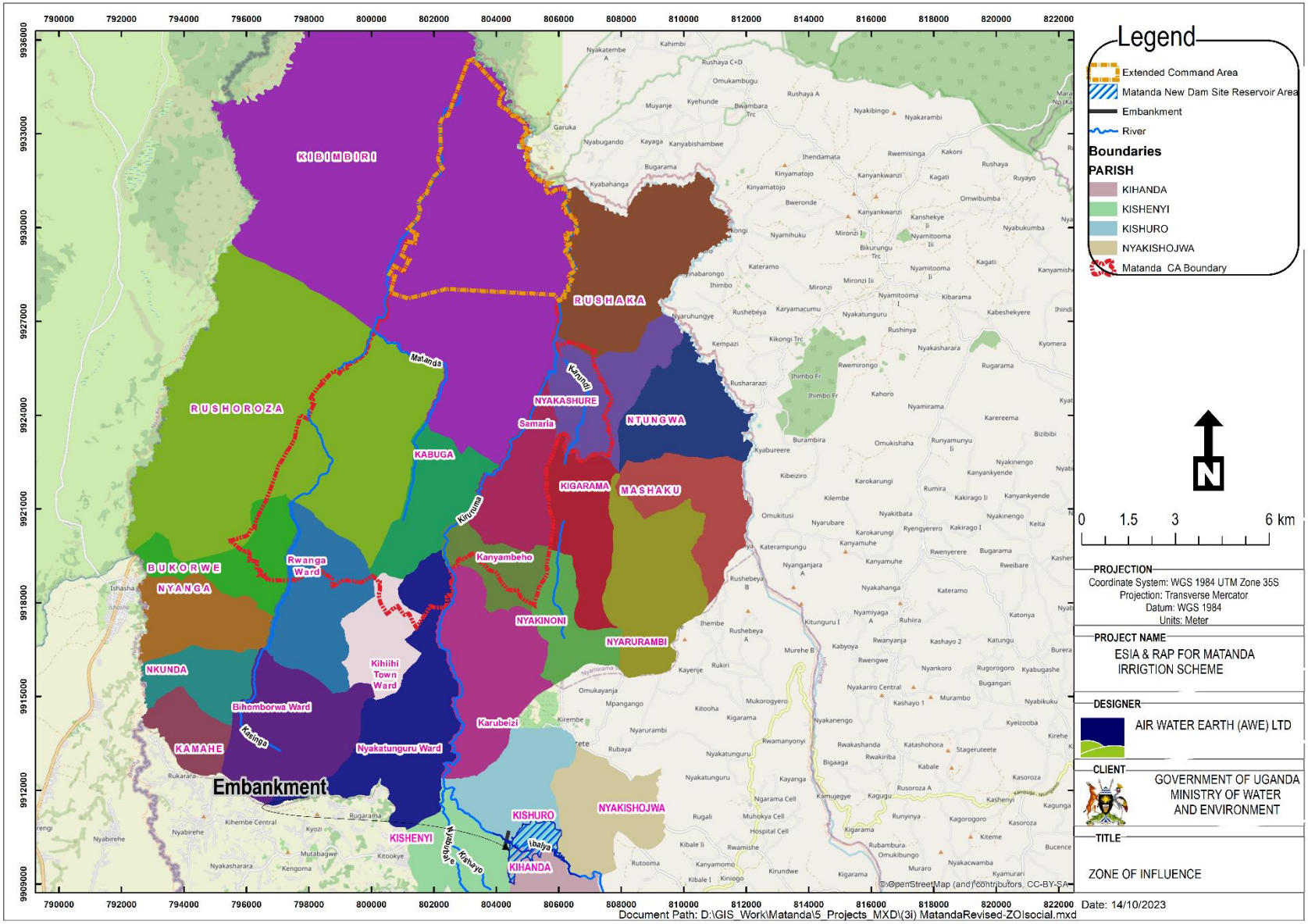


Figure 4-1: Assessed Social project ZOI

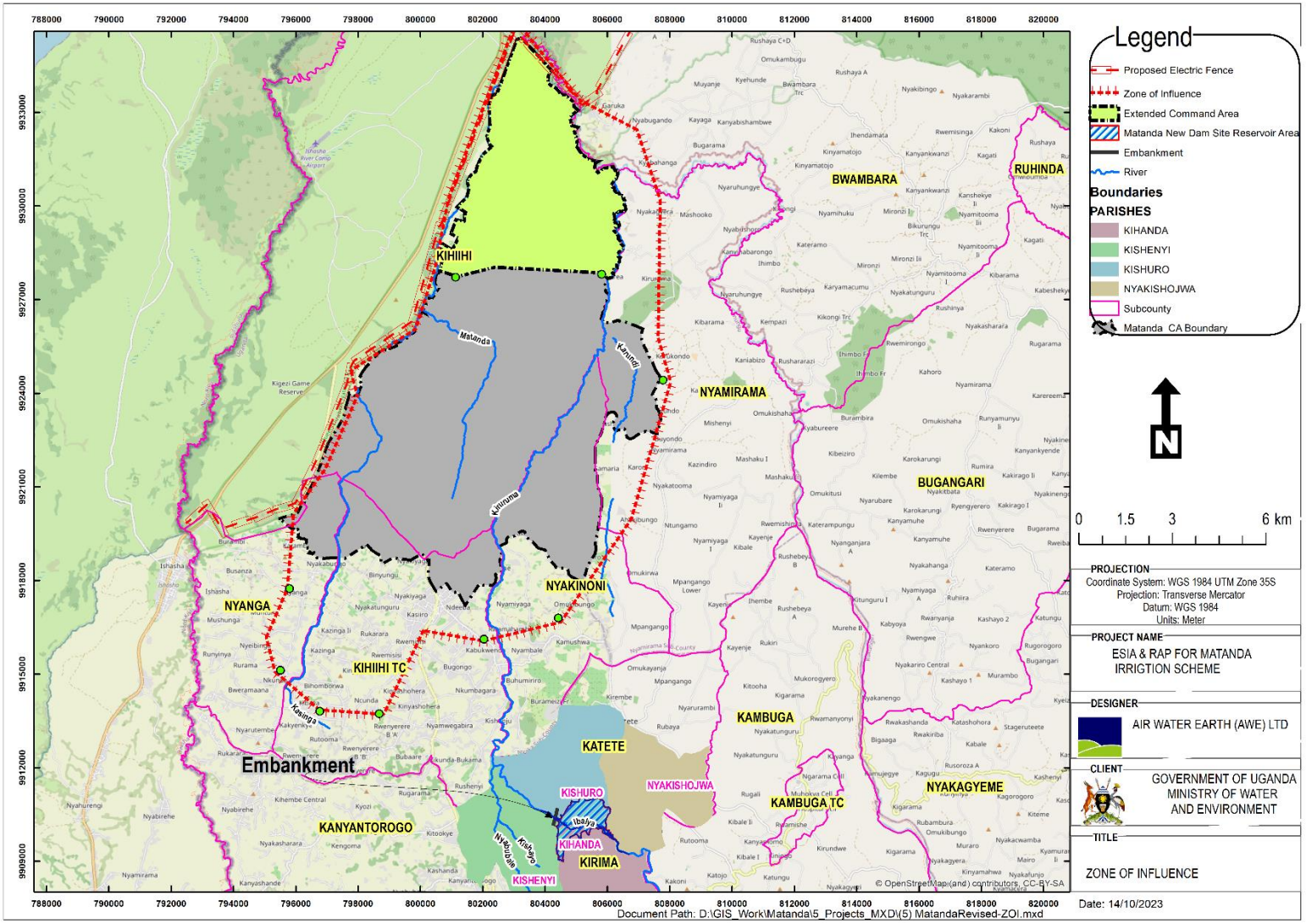
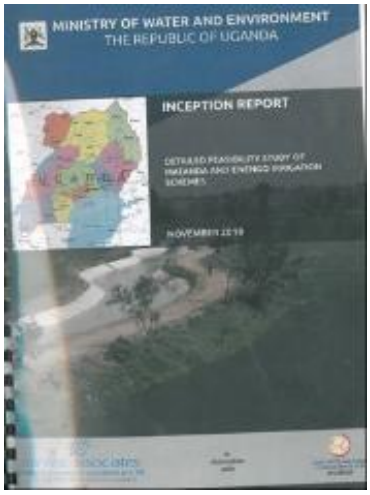


Figure 4-2: Assessed Environmental project ZOI

4.5 Literature Review

A review of the available literature concerning the project was done, to gain an understanding of the project components, scope and extent. Review of the national laws and policies was also done to gain an understanding of the legal and administrative framework for the project. In addition, information available from previous studies such as;

- Request for Proposals for consultancy services for preparation of Environmental and Social Impact Assessment (ESIA) and Development of the Resettlement Action Plan (RAP) for the Matanda Irrigation Schemes.
- Inception report and presentation for the detailed feasibility study of Matanda Irrigation Schemes from Aarvee associates.
- Final feasibility study report for the Project, 2019, 2022
- Draft Detailed Design Report for Project, 2019, 2022
- Preliminary project literature from MWE
- Kanungu Local Government Statistical abstract 2012/13
- MWE ICRP Environmental and Social Management Framework, 2019
- Preliminary design report of the scheme
- Matanda Irrigation ESIA Inception report
- Matanda Irrigation ESIA Scoping report and ToRs
- Uganda National Population and Housing Census 2017
- Letter of approval of scoping report and Terms of Reference for ESIA



4.6 Physical Baseline Data Collection

In addition to the literature review, the environmental conditions of the project area of influence have been assessed by carrying out physical baseline surveys which were intended to provide a measure of the existing environment situation against which future changes due to the project implementation can be monitored. These physical baseline environment studies were to aid in developing appropriate monitoring indicators. For the extended command area, teams carried out field visits for 20-person days from between June 2023 and October 2023.

4.6.1 Geo-referencing

Photo 4-3: Garmin handheld GPS system

All sampling and measurement locations during the site surveys were geo-referenced using portable GPS (GARMIN eTrex Vista HCx-Figure 4-8) and expressed in the WGS 84 system. Locations were selected in consideration of project components, potential receptors and also existing baseline data available as per the project site layout maps, survey reports, scoping and field surveys by different specialist teams.

Maps, Google Earth satellite imagery have been used to clearly show the administrative boundaries, water sources, geology, topology, and site location of the proposed area. A software known as Arcmap11 was used for analysis. Using geo-referencing, the following measurements (Section 1.4.2 to 1.4.4); Air quality, Noise levels and Vibrations were taken at the presented locations in Table 4-1 below. The measurements were monitored over a period of 20 minutes per site.

Table 4-1: Measurement locations in the proposed Matanda irrigation scheme project area

			Air quality	Noise levels	Ground vibrations	Measurement Location	
SUBCOUNTY	PARISH	VILLAGE	*Station ID*	*Station ID*	*Station ID*	*Eastings*	*Northings*
Kihiihi	Kibimbiri	Matanda I	AQ1	N1	V1	129094	9915786
		Omwirangizo	AQ2	N2	V2	135396	9926011
		Kiruruma A	AQ3	N3	V3	136921	9924564
	Rushoroza	Rwerere	AQ4	N4	V4	131536	9923591
		Ibambiro	AQ5	N5	V5	131911	9920731
		Ishasha Sector Barracks &UWA Offices	AQ6	N6	V6	0797961	9920934
		Bukorwe Primary School	AQ8	N8	V8	0796808	9919667
		Bokorwe Catholic Church	AQ9	N9	V9	0803730	9931924
		Kazinga Mosque	AQ10	N10	V10	0805615	9928093
		Kazinga Trading centre	AQ11	N11	V11	0805012	9926091
		Karambi Trading centre	AQ12	N12	V12	0804488	9924812

SUBCOUNTY	PARISH	VILLAGE	Air quality	Noise levels	Ground vibrations	Measurement Location	
			Station ID	*Station ID*	*Station ID*	*Eastings*	*Northings*
		Kyenteija Church of Uganda	AQ13	N13	V13	0804244	9924607
		Kameme Primary School	AQ14	N14	V14	0803621	9923478
	Rushoroza	Kameme Trading centre	AQ15	N15	V15	0801688	9927859
		Global Christs Mission	AQ16	N16	V16	0802394	9930251
		Kameme Trading centre	AQ17	N17	V17	0800679	9923966
		Burimano church of Uganda	AQ18	N18	V18	0800604	9923673
		Burimano Trading centre Mosque	AQ19	N19	V19	0800130	9922157
		Matanda Primary School	AQ20	N20	V20	0800087	9922038
		Matanda Health centre III	AQ21	N21	V21	0802879	9922320
		Matanda Refugee Transit Centre	AQ22	N22	V22	0802875	9922284
	Kibimbiri	Rushoroza Secondary School	AQ23	N23	V23	0802871	9922409
		ST Charles Catholic Church	AQ24	N24	V24	0801771	9919924
		Kibimbiri Parents Primary School	AQ25	N25	V25	0796761	9921054
		Group Farm A Trading Centre	AQ26	N26	V26	0796795	9920949
		Honey Moslem Primary School	AQ27	N27	V27	0804244	9924607
		Rushoroza Primary School	AQ28	N28	V28	0803850	9923376
		Rushoroza Catholic Church	AQ29	N29	V29	0803692	9923497

SUBCOUNTY	PARISH	VILLAGE	Air quality	Noise levels	Ground vibrations	Measurement Location	
			Station ID	*Station ID*	*Station ID*	*Eastings*	*Northings*
		Rushoroza Trading centre	AQ30	N30	V30	0803621	9923478
		Rwerere Trading centre	AQ31	N31	V31	0801553	9926457
		Nyakahita Primary school	AQ32	N32	V32	0801688	9927859
		Kyenyabutongo Trading centre	AQ33	N33	V33	0802394	9930251
		Kyenyabutongo Church of Uganda & Primary School	AQ34	N34	V34	0802493	9928768
	Kabuga	St.Emmanuel Church Health centre II	AQ35	N35	V35	0800771	9924237
		Kibimbiri Church of Uganda	AQ36	N36	V36	0800679	9923966
		Kibimbiri Trading Centre	AQ37	N37	V37	0800604	9923673
		Kyakatarangi Primary School	AQ38	N38	V38	0800130	9922157
		Kiramira Catholic Church	AQ39	N39	V39	0800087	9922038
		Queen Elizabeth P/S and Kashojwa Church of Uganda	AQ40	N40	V40	0799373	9919991
		Bushere Church of Uganda	AQ41	N41	V41	0802879	9922320
		Bushere Health Centre II	AQ42	N42	V42	0802875	9922284
	Bihomborwa Ward	Bushere Primary School	AQ43	N43	V43	0802871	9922409
		Matanda II Church of Uganda	AQ44	N44	V44	0801771	9919924

SUBCOUNTY	PARISH	VILLAGE	Air quality	Noise levels	Ground vibrations	Measurement Location	
			Station ID	*Station ID*	*Station ID*	*Eastings*	*Northings*
Kihiihi Tc		Kazinga	AQ45	N45	V45	134180	9918431
	Rwanga Ward	Kazinga I	AQ46	N46	V46	134595	9913862
	Nyakatunguru Ward	Kinyamashe	AQ47	N47	V47	136220	9920625
	Nyakatunguru Ward	Kishunju	AQ48	N48	V48	138481	9924640
Nyakinoni	Kanyambeho	Kanyambeho	AQ49	N49	V49	135777	9918396
	Samaria	Bushogye A	AQ50	N50	V50	134063	9922554
Nyamirama	Nyakashure	Samaria	AQ51	N51	V51	130168	9918611

4.6.2 Air quality

Baseline ambient air quality was measured using a non-passive sampling method. An active sampling method was used to monitor short-term concentrations of particulates, using an electronic light-scattering device (Casella Microdust Pro™ digital aerosol monitor-Figure 4-9) that monitored short-term concentrations of Total Suspended Particulates (TSP). The Casella Microduct Pro™ aerosol monitor was calibrated before use in the field by inserting a factory-supplied optical filter into its probe and allowing it to span and confirm the reading on the digital screen readout. Toxic and explosive gases (SO2, NO2, and CO) were monitored using a set of three MX6 iBrid™ portable gas monitors (Figure 4-10). The trio of MX6 iBrid™ gas monitors was calibrated before use with manufacturer-specific calibration gases. These digital gas monitors are given gases of known factory-tested concentration at a flow rate of 0.5L/min and allowed to span and automatically calibrate their sensors by following the software generated prompts at room temperature. Spot measurements were undertaken during the field survey and measurement lasted 20 minutes at each air quality monitoring location (Table 4-1 and Figure 4-13) of which GPS coordinates were taken and maps developed. Also, the values for the number of particles for PM10 and PM2.5 were read from the screen and recorded. The monitors were then set to start data logging at a frequency of five (5) minutes for 7-12 hours per site. The data was then downloaded on a PC using S500 V6.5 Software and analyzed. The software generates mass concentration graphs and also provides minimum (min), average (ave) and maximum (max) values for each parameter logged. All conditions (such as vehicle traffic, human activity, motor engines running, weather) during measurements were also recorded.

Photo 4-4: Instrument used – CASELLA MicroDust to measure dust (TSP)

Photo 4-5: MX6 iBrid™ portable gas monitors

4.6.3 Wind and Meteorology

Baseline meteorological conditions such as temperature, humidity, illumination, wind speed and direction were measured using CEM DT 8820 and Kestrel 4500NV pocket weather Tracker (Figure 4-11) at selected locations (Table 4-1 and Figure 4-13). It was important to know these parameters when carrying out Air Quality monitoring measurements. Wind measurements help to estimate the flow pattern of any generated emissions, smoke plumes direction and fire behavior. A time series plotting software was used for wind modeling to generate the wind rose diagram covering the command area. When combined with precipitation data, wind speed is also used to estimate the amount of vegetable cover drying. Data on rainfall of the area comprising the site was obtained from the Department of Meteorology. Wind and air temperature patterns influence extent and intensity of dust migration. Rainfall intensity is a crucial factor of influence in soil erosion.

4.6.4 Noise

Measurement of ambient noise levels was carried out using a precision integrating sound level meter (Figure 4-12), with an active range of 0-140 decibels (dB) and complying with IEC 651 and ANSI S4 standards (bearing a calibration certificate issued by a certified calibration laboratory). A Casella CEL-621C digital noise logger was set to record for a sample period of 30 minutes at each of the selected locations. All the measurements were slowly and impulse timely weighted. The assessment procedure involved downloading and analysing the stored data using Insight Acoustic Casella Analysis Software. The output from the software includes LAeq, LAFmax, and LAFmin, decibel levels at all sampled points, also recording; of percentile parameters LAF50 and LAF90 (the noise level exceeded for 50% and 90% of the measurement period, A-weighted respectively), Location of the measurement points was recorded using a GPS receiver (Table 4-1.). In addition, the prevailing noise sources together with the ambient environment at each location were noted:

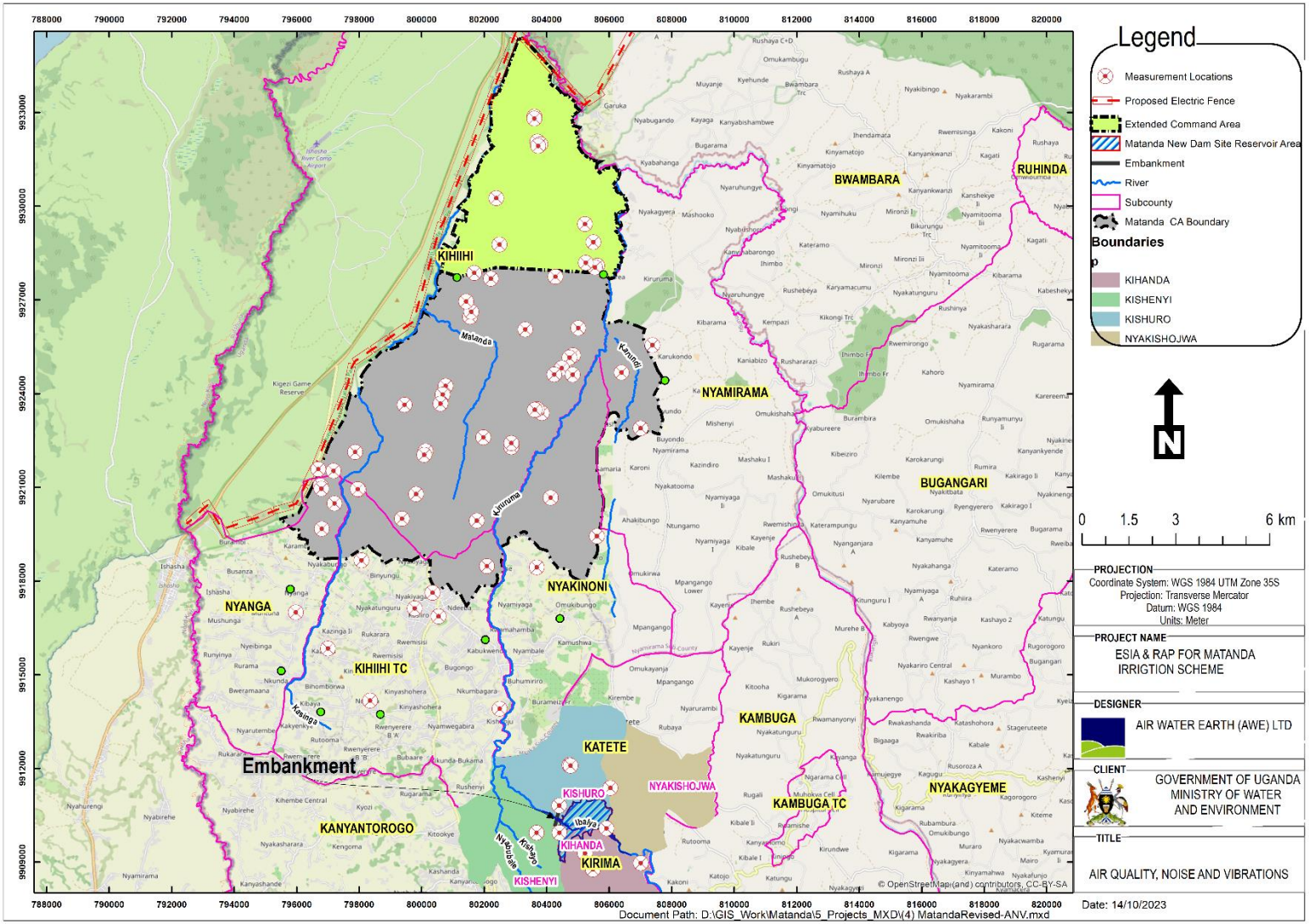


Figure 4-3: Air quality and Noise measurements in Matanda scheme project area

Kichwampare-Kibimbiri

Rushoroza CoU Primary School

Matanda 1

Group Farm A

Mukishunju

Kinyamashe

Kazinga

Kyumbugu

Samaria

Photo 4-6: Noise level measurement at different locations in the proposed Matanda irrigation scheme project area

4.6.5 Ground Vibration

The baseline vibration measurements were taken using a calibrated Nomis SuperMini® Seismograph. The three spikes on the transducer on the seismic channel of the calibrated Nomis Super graph (Figure 4-14) was inserted 3 inches into the soil. The microphone on its sound pressure channel also positioned atop its stake and pointed towards the suspected ground vibrations source. The seismograph, after passing a calibration test was placed in monitoring mode and stabilized readings were taken after a test run of twenty (20) minutes at various selected locations (Table 4-1.)

The parameters measured are velocity and frequency in the vertical, longitudinal and lateral axes ('R', 'T', and 'V') axes as well as sound pressure levels. The maximum recorded readings were then saved. All conditions (such as vehicle traffic, human activity, engines running) during measurement were recorded. The seismograph is factory calibrated and does not require further calibration when used in the field.

Photo 4-7: Field ground vibrations measurement using a Nomis Seismograph

4.6.6 Water Quality

A multi-parameter water quality meter (HANNA HI 9828-Figure 4-15) was used to measure In-situ water quality (Figure 4-17) at various locations (Table 4-2 and Figure 4-16). The water quality meter was first calibrated in accordance with the manufacturer's specification to ensure an accurate representation of the water quality. Water was abstracted in a collection container and a water meter knob immersed in the sample water collected. At each sampling location, three replicates of the sample were measured subsequently to get worthy water quality characteristics. In-situ measurements recorded from the water meter include; concentration of dissolved oxygen, conductivity, resistivity, pH, temperature, salinity, oxidation reduction potential, atmospheric pressure and percentage of dissolved oxygen of the water sample. From the same in-situ measured samples, part was collected in two replicates with labeled containers and preserved in a cool box with ice packs as per ISO 5667 guidelines to ensure integrity of the sampling process for analysis in the laboratory. All samples were sent to Makerere Chemistry Laboratory for analysis. Laboratory analysis was done for the following parameters; Apparent colour (PtCo), Turbidity (FAU), Total suspended solids (TSS), Total Alkalinity (mg/l), Bicarbonate (mg/l), Chlorides (mg/l), Nitrates (mg/l), Ammonia nitrogen (mg/l), Total Phosphorus, Sulphates (mg/l), Total Hardness (mg/l), Fluorides (mg/l), Total iron (mg/l), BOD_5 (mg/l), COD. Measurements were conducted both in the dry and wet seasons.

Table 4-2 Water quality measurement locations

Measurement Location					Measurement Location			
Subcounty	*Station ID*	*Eastings*	*Northings*		*Subcounty*	*Station ID*	*Eastings*	*Northings*
KANYANTORO GO	Mbabazi Felix Spring	797791	9909534		NYAKINONI	R. Kiruruma-Reservoir Area	802527	9913514
KIHIIHI TC	Bugongo BH	801229	9914980		NYAKINONI	R. Kiruruma-Reservoir Area	802527	9913514
KIHIIHI TC	Kabukwenda Stream	801278	9915054		NYAKINONI	R. Kiruruma-Kinyamashe	802516	9919068
KIHIIHI TC	Kinyagwe Protected Spring	798680	9915466		NYAKINONI	R. Kiruruma-Nyakarambi	803666	9921957
KIHIIHI TC	R. Kazinga II	796890	9916148		NYAKINONI	R. Kiruruma-Nyakashure	805103	9923738
KIHIIHI TC	Ndeeba BH	796947	9916302		KIHIIHI	Marita Shallow Well	799429	9925656
KIHIIHI TC	Muzizi Borehole	797414	9917125		KIHIIHI	R. Matanda (Kyoganibanywa)	801262	9925852
KIHIIHI TC	Kinyamashe BH	801914	9917940		KIHIIHI	Spring	802220	9926735
KIHIIHI TC	R. Kazinga	797246	9918167		KIHIIHI	Matanda Protected Spring	805964	9928457
KIHIIHI TC	Nyanga Shallow Well	797195	9918178		KIHIIHI	Kyenyabutongo	802119	9929797
KIHIIHI TC	Binyungu BH	798284	9918181		KIHIIHI	Kazinga BH	798225	9920786
NYAMIRAMA	R. Kiruruma-Samaria	805869	9925454		KIHIIHI	Kazinga Lower BH	798033	9922629
NYAMIRAMA	Tributary to Kiruruma	805869	9925454					

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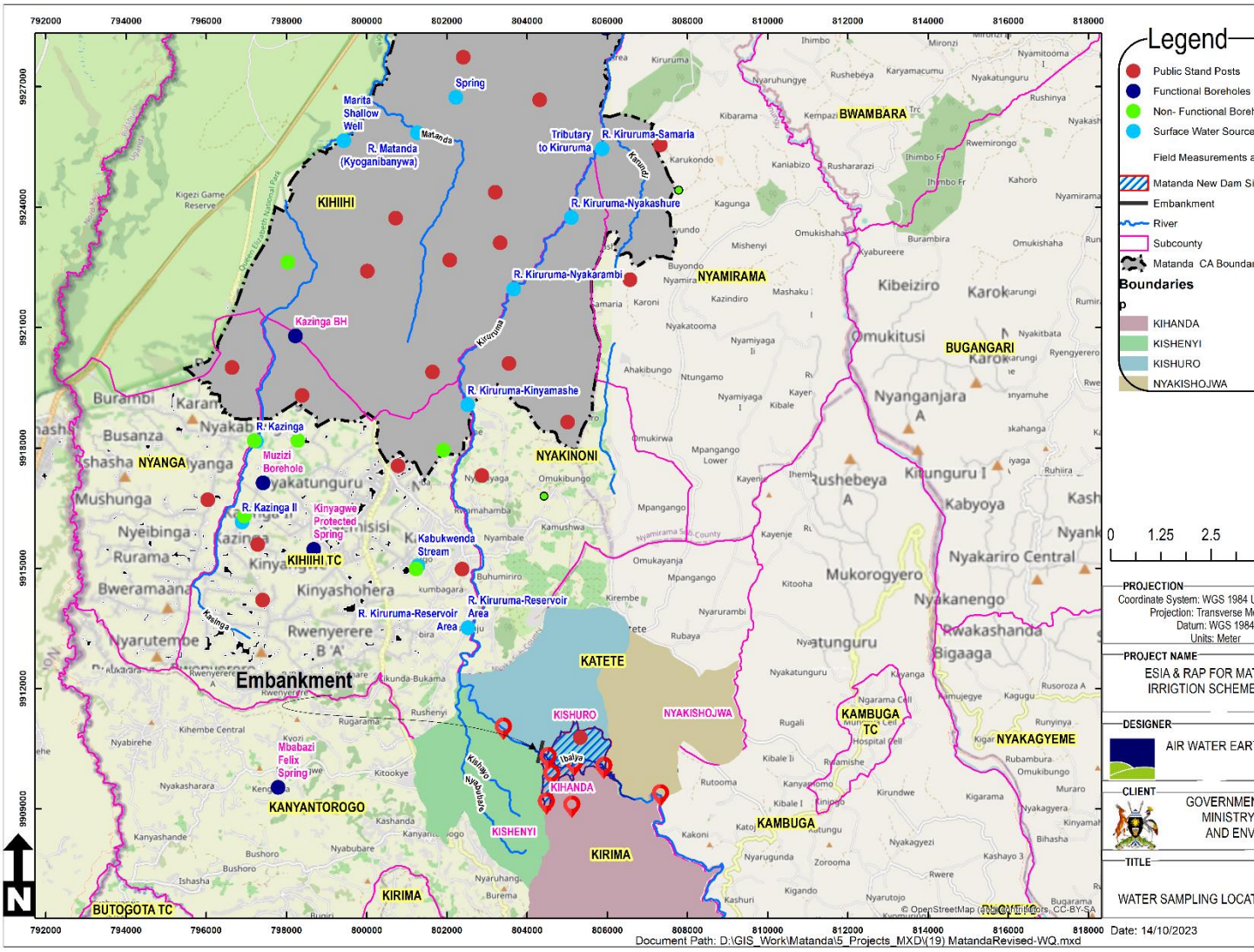


Figure 4-4: Water sampling locations in Matanda scheme project area

R. Kiruruma - Kinyamashe

Insitu water quality

R. Kiruruma – Samaria and Tributary

Kazinga BH

R. Kazinga

Kabukwenda Shallow well

Kiruruma - Reservoir Area

Matanda Protected Spring

NWSC Stand Public Stand Posts

Kinyangwe Protected Spring

Muzizi BH

Marita Shallow well

R. KAzinga II

Mbabazi Felix Protected Spring

R. Matanda (Kyoganibanywa)

Photo 4-8: Sampling points in Matanda scheme project area

4.7 Biological Environment

The study involved a desk review of existing data for the study area and ground truth field observations of existing biological environments in the areas surveyed. The biological survey involved acquisition of biodiversity data to adequately characterize the proposed project area. Surveys were performed across the project area to identify and characterize potentially sensitive receptors. Both floral and faunal species of conservation concern were assessed and documented. The objectives of the study were to:

i. Identify major components of ecosystem including plants, birds, mammals, fish and herpetiles in terms of species, conservation status and habitats,
ii. Assess the status of vermin, invasive species and any other threat to crops of cultivation,
iii. Evaluate the impacts of water uptake from the river basing on the findings from (i) and (ii),
iv. Draw conclusions and recommendations arising from current status of biodiversity and identify opportunities and challenges for the project.

4.7.1 Vegetation, Flora and Habitats Sampling Techniques

Site visits were conducted for the sites including Kazinga upper, Ntungwe Detach, Matanda Lower, Matanda upper, BullBush and Kazinga lower concentrating on remnant riverine natural vegetation and existing plantations and independent rapid biodiversity assessments carried out. During surveys records of features of landscape and environment including the dominant habitats, common species, invasive and noxious species, and species of conservation concern were made at specific points. The entire area was slowly walked, carefully observing the turnover of vegetation communities and flora present. Estimates of species cover on DAFOR scale where D=Dominant, A=Abundant, F=Frequent, O-Occasional and R=Rare. The current status of sites, signs of usability and presences of invasive species were made at regular intervals. Opportunistic recording of species at the regular survey locations was made. The geo-data of each survey location, including geographical coordinates and altitude, were recorded. Photographs and notes were made at different points of interest. The description of vegetation by Langdale-Brown *et al*. (1964) was followed to characterize the vegetation at the site. Habitat sensitivity was assessed on account of presence of taxa that are IUCN Red listed as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU); endemic and near-endemic taxa; as well as rare taxa. Ecosystems with fragile watersheds, riparian environments were also highlighted.

4.7.2 Birds

Line transects counts

The standard Bird Population Monitoring methods (Nature Uganda 2010) were followed. Under this method, birds were surveyed by establishing and moving along transects in and around the project areas. Some of the areas

covered included pockets of natural vegetation that were present and gardens. The line transect is a highly adaptable method in terrestrial ecosystems and is universally applied to species from different ecological categories (Gibbons and Gregory 2006). In the field, birds were identified with the help of a pair of binoculars and with bird guides by Stevenson and Fanshawe (2002) and their known range of geographical distribution confirmed using Carswell *et al* (2005).

Habitat Classification

The Birds recorded were classified into categories based on the standard habitat classification by Bennun and Njoroge (1996) and Carswell *et al*. (2005). This classification is widely used in evaluation of avifauna in Uganda. The categories are;

i) F - Forest generalist (species less specialized also occur in small patches of forests)
ii) G - Grassland species
iii) f - Forest visitor
iv) W - Water specialist (normally restricted to wetlands or open waters)
v) w - widespread species

Conservation Status

Birds were further classified according to their conservation status i.e., whether they are species of conservation concern, according to IUCN Red List of globally threatened species with categories:

i. CR - Critically Endangered
ii. EN - Endangered
iii. VU - Vulnerable

4.7.3 Mammals

Direct methods

Direct methods were; mammal sightings and species counts along transects in the project area and fringes. This involved walking from point to point searching, enumerating, and recording mammals (large, medium and small sized) seen along transects.

Indirect methods

Indirect methods were identification of mammalian dung, calls, tracks, and footprints. These methods were adopted in surveys of small, medium, and large sized mammals although they are more efficient with the latter two. They come into use due to the difficulty of coming in sight of or capturing some mammals (Lyra-Jorge *et al*. 2008) although

some Shermann traps were used to trap small mammals where vegetatation allowed. Data from each of these methods was noted as encountered along transects and occasional encounters while walking in transects.

Pooled local expert opinion

A modification of the Pooled Local Expert Opinion (PLEO) method on local informants was used. This method was vital for assessing species presence, density and range estimations and was based on residents with good knowledge on mammals in the area (van der Hoeven *et al*. 2004). Residents and farmers within the project area were asked to tell the presence of mammals' abundance.

Data analysis

Species richness and abundance
A species list indicating species richness was generated after identifying all individuals encountered to species level and use of curated data from Makerere University Museum to determine collected specimens and indices.

Conservation status

The conservation status for each individual recorded in each of the taxon was obtained from the published and most recent IUCN Red List data (2019) and the red list of Uganda's threatened species by WCS (2016). In these resources, species were assessed as to whether they are **CR** – *Critical,* **EN** – *Endangered,* **VU** – *Vulnerable,* **NT** – *Near-threatened,* **LC** – *Least concern or* **DD** – *Data deficient.*

4.7.4 Amphibians and Reptiles

Due to limited time, three sampling methods including Visual encounters surveys (VES), Opportunistic observations, and Audio surveys were used in the study. Surveys involved walking through the sites systematically searching and recording species and numbers of amphibians and reptiles and the method focused on surface-dwelling amphibians and reptiles. This was supplemented with opportunistic encounters as well as identifying using vocalizations by individuals that actively produce sound.

Identification

Identification was done using available standard reference books namely; Spawls, *et al* (2008), Branch, B. (2005), Schiotz (1999), and Drewes and Vindum (1994). While the IUCN (2019) Red List of Threatened Species and National Red List for Uganda (WCS 2016) were consulted for threat status of individuals that were identified.

Data Analysis

Critical Habitats and Vegetation

To delineate the land cover in the project area, the landscape was put to phytosociological descriptions. Field observation and use of Langdale-brown *et al*. (1964) system made the basis for analysis of landscape cover types. Pictorial illustrations of the different land cover types are provided in the results section.

Existing forms of Disturbances

Different forms of disturbances at each of the study points were recorded and pictures taken for illustrations.

Species threat levels and Invasiveness

The conservation status for each species was obtained from the published most recent IUCN (2019) Red List data list and the National red list of Uganda's threatened species (WCS 2016). Invasive species considered here included those that are exotic and have threats to native species at both individual and ecosystem levels.

4.7.5 Fish

Surveys for both fish and invertebrates were done at different sites in River Kiruruma, Ntungwe and Kazinga (Kiruruma S1-S5, Ntungwe bridge, Ntungwe Bull Bush, Kazinga upstream 1-2 and downstream 1-2) to ascertain presence that had been indicated during the scoping surveys as well as the species richness and variability. The surveys were done through experimental fish catches supplemented by artisanal fish catches from the locals who used mainly hooks. River Kiruruma is endowed with a variety of fish species that thrive throughout the different river sections, especially during the wet and high-water level seasons. The key interest during these fish and invertebrates' surveys was to determine whether there were species of special water level needs as well as those of conservation concern.

Sampling for macro-invertebrates

Benthic macro-invertebrates were sampled using a kick-net ($1m^2$). The kick-net was vertically fixed at the downstream end of the estimated area to be sampled. Bottom substrates within the $1m^2$ area were shifted about using both feet for about 2 minutes. The dislodged macro-invertebrates drifted by water into the kick-net set downstream. The trapped organisms were transferred from the kick-net to a bucket and concentrated using a washing bag (mesh size 500µm). Two samples from differing points of the bottom of the site were taken and pooled. The macro-invertebrates were placed in sample bottles and preserved using 70% ethanol. The preserved organisms will be transported to the laboratory for sorting, identification and quantification.

Photo 4-9: Biodiversity assessment – Fish surveys (A) upstream and fyke net (B) from the downstream areas during e-flow assessments of R. Kirurma for the proposed Matanda Irrigation Scheme.

4.8 Social Economic Baseline

This section describes the study methodology that was adopted to carry out this socio-economic study, with specific reference to the study site, data collection and analysis.

4.8.1 Social Economic conditions

Socio-economic baseline conditions survey was important in understanding potential socio- economic positive and negative, direct and indirect, immediate and long term, and permanent and temporary impacts of the project components. Socio-economic baseline conditions, such as; Land use in site zone of influence, Existing infrastructure, Settlement patterns, Circulation patterns, Social cohesion, Population demographic, Community structure, Employment characteristics, Local economy and income distribution, Social services, Indigenous peoples, ethnic or tribal customs, Physical cultural resources, Public health, Gender-based violence and violence against children, Agricultural patterns, etc.

4.8.2 Objective of Socio-economic baseline study

This socio-economic feasibility study was guided by one major objective as proposed by NEMA approved Scheme ESIA-Terms of Reference to: *(a) -Provide a detailed description of the contemporary baseline information (biophysical and socio-economic) of the project site and its environment.*

Therefore, the main objective of the study was to establish a baseline socio-economic setting in the project area and conduct a socio-economic analysis to determine the potential socio-economic impact of the proposed project on the local population and propose mitigation measures for identified socio-environmental impacts.

Specifically, the study was;

- To assess the existing situation of the proposed project area.
- To analyze the socioeconomic impact of the proposed project on the local community.
- To collect the community's expectations and fears about the proposed project.
- To build a prior trust between stakeholders of the project and local community.

4.8.3 Scope of socio-economic study

The socioeconomic situation of the project area was conducted between June and October 2023 in Kanungu District, Nine (9) Sub Counties; Kihiihi, Kihiihi Tc, Nyakinoni, Nyamirama, Nyanga, Kirima, Kambuga, Katete and Kanyantorogo sub counties, 19 parishes and 124 villages. The social team was helped by local council leaders and Kanungu District officers during the social economic survey. The study encompassed a review of information on existing socioeconomic situation, level of education, agricultural and physical infrastructure condition, existing natural and human resources from the previous social economic studies conducted in the area. The updated report expanded on the existing administrative area and included 5 more villages of Kameme, Matanda, Kanyinabulimano, Kinyabutongo, and special area.

4.8.4 Study design

Design of the socio-economic baseline study was cross-sectional descriptive involving both quantitative and qualitative methods of data collection and analysis. The qualitative methods were used in order to cater for parts of the study that required in depth understanding and also for the purpose of data triangulation.

Quantitative Sampling Procedure

Based on the 18987 households in the cited sub counties according to the 2014 Uganda Population and Housing Census, (UBOS, 2014). 30% households were targeted from each command area delineated village in the 5 sub counties. A combined total of 2144 randomly targeted household composition included heads of household or other responsible adult household members. Once a household was identified, the household head was selected to participate in the study and if the household head was absent or otherwise unable to participate, he/she was substituted with any other adult member of the household that was deemed capable of providing information about the household. Purposively an inclusion of 15 Batwa community representatives from 10 households participated as a minority group in the Project area

Qualitative Sampling Procedure

For qualitative studies, purposive sampling procedure was used, to select study participants. This sampling technique entailed inclusion of information-rich participants, based on their perceived role in the project area. The key participants included Farmers associations, farmers, production department of Kanungu District (LCV Chairperson, District Natural Resources Officer (Environment Officers), District Production Officer, District Community Development Officer, District Water Officer, and District Secretary for Production. The Sub County sample included:

Subcounty Chief, Community Development Officer, and LC III Chairperson), the Sub County leadership (Sub County Chief, Community Development Officer, and LC III Chairperson), parish level (Parish chief, LC II Chairperson, Cultural leaders,) Batwa cultural leaders, religious leaders and LCI chairpersons of the various villages. Furthermore, the community was sensitized and a discussion was conducted there after seeking options of the participants in respect to perceived project benefits, fears and concerns for project implementation. The responses to the discussion will be considered as qualitative finding in chapters 6.

4.8.5 Methods of data collection

Primary data was collected by interviewing members of the study population as described above. Several methods of data collection were employed to collect primary data including structured interviews, key informant interviews (KIIs), and focus group discussions (FGDs). The study was conducted through a participatory approach and comprised the following techniques:

a) Observation

During the study, transect walks were concentrated around the project area, collecting specific information regarding agricultural practices, general housing conditions, infrastructure, basic facilities and amenities such as electricity, education, health, and other institutions, etc. for a vivid description of the project social-economic-health setup. Significant photographs were taken of the original situation on the ground to give an informative view of the current issues in relation to the proposed scheme. These photographs can also be used for future monitoring and evaluation of the impacts of the project in the project area. This method was used as a platform to bear firsthand understanding from the responses provided in other methods and for picking additional information not picked up through other methods.

b) Focus group discussions

The community level sample on the other hand comprised individuals targeted for participation in focus group discussions. These included members of the community especially the women, youth, and farmers (Figure 4-19). Selection of the community-level sample targeted individuals that were deemed to be knowledgeable about their community and able to participate freely in a group discussion and more especially those who would be affected by the proposed project. They were identified with the help of local community leaders. For this purpose, guiding questions were used for interactions and data collection. These consisted of open and close ended questions.

Farmers women Youth

Photo 4-10: Socio-economic focus group discussions

c) Interviews

- *Semi-structured interviews*

The structured interview method (Figure 4-20) was used to collect household data with the aid of a structured questionnaire. Key informant interviews were used to collect data from informed and influential individuals, community agricultural related associations and credit forums, district level and Sub County level leaders, local council chairpersons as to collect general information related to the project area. The survey interviews were administered using the questionnaire.

Photo 4-11: Socio-economic Semi-structured interviews

- *In-depth interviews*

Selection was based on the subject's profession or status within the project area in relation to the information needed by the study, for instance the topics to be discussed. Information obtained from in-depth interviews (Figure 4-21) helped to contextualize some of the information obtained from the questionnaire.

Photo 4-12: Culture and heritage/ Socio-economic in-depth interviews

4.8.6 Data quality control measures

The lead sociologist coordinated and supervised the entire process of the socio-economic survey. She was in the field to supervise and guide the data collection process and was directly involved in data collection.

Recruitment and selection of enumerators was done emphasizing minimum academic qualifications, experience, socio-cultural compatibility and gender balance. 15 enumerators were recruited targeting university graduates and social scientists with knowledge and experience of socio-economic and behavioural studies using both qualitative and quantitative methods as well as ability to speak the local language. The enumeration team was gender balanced (7 females and 8 males respectively). The cited team was also reinforced and supported by representative from the Ministry of Water (WfP department), Kanuagu District (Agricultural production department), and 5 sub counties representatives in their delineated jurisdiction and two (2) drivers who were responsible for the team's logistical needs during the field survey.

To enhance their data collection ability and to build their confidence before the actual field activity, the enumerators received a one -day rigorous training involving introduction to the basic survey methodologies, administering a questionnaire, conducting KIIs, FGDs, recording responses, and supervised interview practice through mock sessions. In addition, a one-day field pre-test was conducted (8th August, 2019) and evaluated for relevance of the survey questions and the potential survey implementation challenges. This also served to further polish the data collection skills of the enumerators and refine the data collection tools. The field research team met on a daily basis to review the day's field performance, compare notes and to plan for the next day. This was aimed at enhancing reliability and consistency of the collected data.

4.8.7 Data analysis

Quantitative data was cleaned, entered and analysed using the SPSS 16 computer software. Frequency and percentage tables as well as bar charts were generated and used to present the quantitative results. Qualitative data was assembled and typed into a Microsoft Word processing program. The data was then subjected to analysis using the SPSS 16 computer software.

Content thematic approach as well as classifying responses into meaningful categories so as to bring out their essential pattern was used in making inferences. The qualitative analysis largely followed the questions and themes of the study. During qualitative data analysis, tentative themes found to lack data to support them and others that were not accommodated in other themes were merged. Bearing in mind the objectives of the survey, data content and the survey context, relationships between codes, themes and different levels of themes were noted. Hereafter, more reviews and refinement of themes was done to ensure that they formed coherent patterns. Salient phrases and quotations on emerging themes have been reproduced verbatim and integrated in the report. Qualitative and quantitative findings have been integrated in the single socio-economic section in the ESIS.

4.8.8 Ethical considerations

Permission to conduct the study was sought from relevant leaders, including; Kanungu District, 6 Sub-counties, 22 Parishes and 140 community local government authorities. All participants in the study were informed that participation in the survey was voluntary and all information collected at the household level would be kept confidential and would be used only for its intended purpose.

4.9 Archaeology and Cultural Heritage

Archaeological surveys were done to examine the earth's surface for sites and archaeological record such as artifacts, eco-facts and features for example stone and bone tools, metallurgical implements, potsherds and others, bones, skeletons and storage pits, fireplaces (hearths), house foundations or even rock paintings and engravings on cave walls or boulders.

For Ethnographic surveys, consultations with communities and other stakeholders were done to gain an understanding of interpretations on some sites since these are regarded to be custodians of our recent past histories.

Community oral interviews were also conducted to identify sites of cultural heritage importance and their significance. Stakeholders guided the survey team to some of the heritage sites and gave recommendations on what shall be done in case the heritage was to be affected by the proposed project.

4.10 Stakeholder Consultations

4.10.1 Objectives of stakeholder engagement and consultation

Stakeholder engagements under this study was guided by one major objective as proposed by NEMA approved Scheme ESIA-Terms of Reference to: *(c)- Ensure that comprehensive consultations are carried out with all key stakeholders, including the local community around the project area, and that the views/concerns of the stakeholders are well documented and integrated in the ESIA report*;

The objectives of the engagement were to share project information with a wide range of stakeholders, to obtain baseline information, and to allow stakeholders the opportunity to make comments and express their views on the proposed project's impacts and mitigation measures to address these impacts. It was important to share the project benefits and adverse impacts, as well as the proposed enhancement and mitigation measures. Information that was disclosed during the engagement included details of the purpose, nature, location and duration of project activities.

Stakeholder engagement constituted an important part of the ESIA, in light of the project's commitment to adhering to national requirements, as well as a best practice approach to public consultation, *i.e.,* an approach that encouraged

open and transparent dialogue, with as broad a range of stakeholder groups as possible. The broader aims of these consultations were to:

- Provide timely and transparent information on the project to relevant stakeholders at an early stage in the project lifecycle;
- Provide an opportunity for stakeholders to give their feedback on the project; and
- Ensure that this ESIA takes into account stakeholder views.

The more specific objectives of the environmental and social consultations were to:

- Consult with key strategic stakeholders on specific issues of interest / concern to them;
- Obtain preliminary baseline data (local knowledge);
- Gauge attitudes towards the project;
- Identification of positive and negative impacts, and possible mitigation measures including alternative livelihood strategies; and
- Gather recommendations and suggestions.

4.10.2 Scoping exercise stakeholder analysis

Three steps were undertaken for preliminary stakeholder analysis at scoping stage, including;

a) Stakeholders' identification

Preliminary identification of stakeholder groups started with investigating specific threat and opportunity factors and developing a list of key stakeholders associated with each. This was based on the five (5) key questions below:

i. Who are key players in development and implementation of the project?
ii. What key resources will be impacted?
iii. Who is most dependent on these resources?
iv. Which government sectors and ministry departments are involved?
v. Which agencies license certain aspects of the project or are most knowledgeable about, and capable of dealing with project impacts or resources to be affected? Who is managing these resources?

b) Interests, influence & importance of stakeholders

To assess influence and importance of each stakeholder and potential impact of the project upon each stakeholder, the six (6) key issues investigated included:

i. Who is directly responsible for decisions on issues important to the project?
ii. Who holds positions of responsibility in interested organizations?
iii. Who is influential in the project area (both thematic and geographic areas)?

iv. Who will be affected by the project?
v. Who will promote/support the project, provided that they are involved?
vi. Who will obstruct/hinder the project if they are not involved?

c) Stakeholders' engagement

Finally, the third step was determining how to involve the different identified stakeholders. It was evident that different stakeholders were to be engaged in different ways at the various stages of the project, from gathering and giving information, to consultation and dialogue. Stakeholder engagement was guided by World Bank/IFC guidance note[3]. The approaches that were used during the consultations have been tabulated below (Table 4-3)

Table 4-3 Approaches used during consultations

Consultation approach	Techniques that were used to conduct consultations, include; ✓ Individual interviews; ✓ Local community meetings; and ✓ Face-to-face meetings.
Dialogue approach	ECOS approach was used to guide the scoping stakeholder discussion. That's is; ✓ E - Existing condition of the project area ✓ C - Challenges faced by the communities in the project area ✓ O - Opportunities that can be realised as a result of project implementation ✓ S - Stakeholders that shall be consulted or brought on board in relation to the project.

After assessing, like in the earlier studies of the original command area of 4420 hectares, two sub counties, Kihihi and Nyamirama, were sampled since they were cited as major agricultural oriented sub counties in the Kanungu District based on the results of the stakeholder engagement, and one village, Kyaburere, was sampled on basis of presence of the micro demonstration irrigation scheme. During the initial stakeholder engagements (26th June - 28th June 2019), the most influential and community representative stakeholders were chosen, and they engaged. Said engagement continued to be a reference point during the updated studies between June and October 2023.

4.10.3 Detailed ESIA stakeholder analysis

Stakeholder consultations are essential for acceptance and ownership of the proposed project. The cited three steps adopted during scoping exercises were refined and adopted during the detailed ESIA stakeholder analysis. Based on stakeholder analysis, step one and two under scoping exercises, the identified National Local, and community stakeholders were consulted during this study stakeholder engagement. Relevant project information was provided to stakeholders so as to understand project risks, impacts and opportunities. Consultations took place from 14th Nov - 25th Nov, 2019; minutes were recorded as presented in Chapter 6 and Appendix C. The consultant has updated

[3] Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets, available at www.ifc.org/HB-StakeholderEngagement).

the consultation between 8th – 12th August 2023 to update the stakeholders on the added scope of work but also capture their views regarding this extention of the command area.

4.11 Impact identification and assessment

4.11.1 Impact Description

Describing a potential impact involves an appraisal of the scheme characteristics, together with the attributes of the receiving environment. Relevant impact characteristics may include whether the impact is:

a) Adverse or beneficial.
b) Direct or indirect.
c) Short, medium, or long-term in duration; and permanent or temporary.
d) Affecting a local, regional or global scale; including trans-boundary; and
e) Cumulative

Each of these characteristics was addressed for each impact. Consideration of the above gives a sense of the relative **intensity** of the impact. The **sensitivity** of the receiving environment was determined by specialists based on the baseline data collected during the study.

4.11.2 Impact Evaluation

Each impact was evaluated based on impact intensity and receptor sensitivity, using the criteria listed inTable 4-4.

Table 4-4: Classification of impact evaluation

	Classification	Description
1	Extent	Evaluation of the area of occurrence/influence by the impact on the subject environment; whether the impact will occur on site, in a limited area (within 2 km radius of the site); locally (within 5 km radius of the site); regionally (district wide, nationally or internationally).
2	Persistence/Duration	Evaluation of the duration of impact on the subject environment, whether the impact was temporary (<1 year); short term (1 – 5 years); medium term (5 – 10 years); long term (>10); or permanent.
3	Social Context / Sensitivity or Potential for Stakeholder Conflict:	Assessment of the impacts for sensitive receptors in terms of ecological, social sensitivity and such things as rare and endangered species, unusual and vulnerable environments, architecture, social or cultural setting, major potential for stakeholder conflicts. The sensitivity classification is as below:

	Classification	Description
		High sensitivity: Entire community displacement, destruction of world heritage and important cultural sites, large scale stakeholder conflict, etc. ***Medium sensitivity:*** Displacement of some households, moderate level of stakeholder concern ***Low sensitivity:*** No displacements, no potential for stakeholder conflict.
4	Regulatory and Legal Compliance:	Evaluation of the impact against Local and International legislative requirements. ***High:*** Prohibition terms for specific activities/emissions. Major breach of regulatory requirements resulting in potential prosecution or significant project approval delays. ***Medium:*** Potential breach of specific regulatory consent limits resulting in non-compliance. ***Low:*** No breach of specific regulatory consent limits anticipated.
5	Overall Impact rating (Severity):	Using a combination of the above criteria, the overall severity of the impact was assigned a rating Severe, Substantial, Moderate, Minor, and Negligible. Refer to Table 5.2 for broad categories of impact for each rating. **Note:** These are just guidelines that will constitute professional judgment required in each individual case.

4.11.3 Impact Significance

Impact significance was evaluated and presented pre- and post-mitigation. To provide a relative illustration of impact significance, it was useful to assign numerical or relative descriptors to the impact intensity and receptor sensitivity for each potential impact on the basis of ecological-toxicological, physical-chemical and social studies and expert judgment. Each was assigned a numerical descriptor of 1, 2, 3, or 4, equivalent to very low, low, medium or high (Table 4-6). An example is presented in Table 4-5.

Table 4-5: Example of Impact significance scale gradation for environmental impacts

Scale of Impact Intensity	Criterion	Score
Very low	Environmental changes are within the existing limits of natural variations	1
Low	Environmental changes exceed the existing limits of natural variations, but the natural environment is completely self-recoverable.	2
Medium	Environmental changes exceed the existing limits of natural variations and result in damage to the separate environmental components, however the natural environment remains self-recoverable.	3
High	Environmental changes result in significant disturbance to particular environmental components and ecosystems. Certain environmental components lose self-recovering ability.	4

Table 4-6: Criteria for rating impact intensity and likelihood

Criteria	Rating scales
Intensity (The expected magnitude or size of the impact)	**Very Low** - where the impact affects the environment in such a way that natural, and /or cultural and social functions and processes are negligibly affected and valued, important, sensitive or vulnerable systems or communities are negligibly affected.
	Low - where the impact affects the environment in such a way that natural, and/or cultural and social functions and processes are minimally affected and valued, important, sensitive or vulnerable systems or communities are minimally affected. No obvious changes prevail on the natural, and / or cultural/ social functions/ process as a result of project implementation.
	Medium - where the affected environment is altered but natural, and/or cultural and social functions and processes continue albeit in a modified way, and valued, important, sensitive or vulnerable systems or communities are moderately affected.
	High - where natural and/or cultural or social functions and processes are altered to the extent that they will temporarily or permanently cease, and valued, important, sensitive or vulnerable systems or communities are substantially affected. The changes to the natural and/or cultural / social- economic processes and functions are drastic and commonly irreversible.
Probability (The likelihood of the impact occurring)	**None** – where the impact will not materialize.
	Low – where the possibility of the Impact materializing is low (<20%).
	Medium – where there is a good possibility (30%-60% chance) that the impact will occur.
	High – where it is most likely (60% -100% chance) that the impact will occur.

The significance of impact was then indicated by the product of the two numerical descriptors (Table 4-8), with significance being described as negligible, minor, moderate or major, as illustrated in Table 4-7. This was a qualitative method designed to provide a broad ranking of the different impacts of a project.

Table 4-7: Impact assessment criteria and rating scale

Impact Rating	Impact Description
Major	▪ Highly noticeable, irreparable effect upon the environment ▪ Significant, widespread and permanent loss of resource ▪ Major contribution to a known global environmental problem with demonstrable effects ▪ Causing mortality to individuals of a species classified as globally or regionally endangered ▪ Major expedience of water/air quality and noise guidelines representing threat to human health in long and short term ▪ Causing widespread nuisance both on and off site
Moderate	▪ Noticeable effects on the environment, reversible over the long term ▪ Localised degradation of resources restricting potential for further usage ▪ Sub-lethal effects upon a globally or regionally endangered species with no effect on reproductive fitness and/or resulting in disruption/disturbance to normal behaviour returning to normal in the medium term ▪ Elevated contribution to global air pollution problem partly due to preventable releases ▪ Frequent breaches of water/air quality and noise guidelines

Impact Rating	Impact Description
	▪ Causing localised nuisance both on and off site
Minor	▪ Noticeable effects on the environment, but returning naturally to original state in the medium term ▪ Slight local degradation of resources but not jeopardising further usage ▪ Disruption/disturbance to normal behaviour of a globally or regionally endangered species returning to normal in the short term ▪ Small contribution to global air problem through unavoidable releases ▪ Elevation in ambient water/air pollutant levels greater than 50% of guidelines ▪ Infrequent localised nuisance
Negligible	▪ No noticeable or limited local effect upon the environment, rapidly returning to original state by natural action ▪ Unlikely to affect resources to noticeable degree ▪ No noticeable effects on globally or regionally endangered species ▪ No significant contribution to global air pollution problem ▪ Minor elevation in ambient water/air pollutant levels well below guidelines ▪ No reported nuisance effects

Table 4-8: Determination of impact significance

			Sensitivity of receptor			
			Very low	Low	Medium	High
			1	2	3	4
Intensity of impact	Very low	1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low	2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium	3	3 Minor	6 Moderate	9 Moderate	12 Major
	High	4	4 Minor	8 Moderate	12 Major	16 Major

4.11.4 Cumulative Impacts

Cumulative effects manifest when socio-environmental conditions are already or will be affected by past or reasonably probable future development or activities. Cumulative Impact Assessment has been conducted as required by Regulation 15 of the National Environment and Social Assessment Regulations, 2020 and the

requirements of the IFC's Performance Standard 1 (PS1), following a six-step process (Table 4-9) applying the concept of Valued Environmental and Social Component (VEC).

Table 4-9: Cumulative Impact Assessment steps

Steps	Guiding Questions
Step 1: Scoping Phase I – VECs, Spatial and Temporal Boundaries	Which VEC resources, ecosystems, or human values are affected? Are there concerns from existing cumulative impacts?
Step 2: Scoping Phase II – Other Activities and Environmental Drivers	Are there any other existing or planned activities affecting the same VEC? Are there any natural forces and/or phenomena affecting the same VEC?
Step 3: Establish Information on Baseline Status of VECs	What is the existing condition of the VEC? What are the indicators used to assess such conditions? What additional data are needed? Who may already have this information?
Step 4: Assess Cumulative Impacts on VECs	What are the key potential impacts and risks that could affect the long-term sustainability and/ or viability of the VEC? Are there known or predictable cause-effect relationships? Can these impacts and risks interact with each other?
Step 5: Assess Significance of Predicted Cumulative Impacts	Do these impacts affect the sustainability and/or viability of the resource and/or VEC? What are the consequences and/or trade-offs of taking the action versus no action?
Step 6: Management of Cumulative Impacts – Design and Implementation	How can cumulative impacts be avoided, minimized, and/or mitigated? How can the effectiveness of proposed management measures be assessed? What are the triggers for specific adaptive management decisions?

Residual cumulative impacts were assessed, taking into consideration:

- the residual impacts of the project
- the additional management strategies and mitigation measures proposed to manage cumulative impacts.

The significance of cumulative impacts was determined qualitatively based on a predicted exceedance of VEC thresholds, limit of acceptable change or preferred condition. The selection of VECs was done and was based on their viability or sustainability to remain diverse and productive over time despite the irrigation scheme. There is a need to ensure sustainable use of resources by both developers and communities. Generally, during VEC selection several factors were taken into account namely; a) Abundance at sample sites; b) Ecological importance; c) Human health; d) Socio Economic importance; e) Cultural heritage; f) Data Availability. The selected VECs are based on

social safeguard perspectives and the impacts on VECs presented are successive, incremental, and/or combined, induced.

The ESIA has identified current, past and probable future similar activities that may compound socio-environmental conditions in the project area. The possible collective effects of the Matanda irrigation scheme and of other external stressors (developments) on the VECs were considered. Explicitly, considering the effects of extra interactions with other projects on an appropriate scale, considering past, present and future impacts on the same VEC. Therefore, it involves the assessment of the contribution of the Matanda irrigation scheme to the predicted cumulative impacts.

If the governmental agencies identify the need to implement regional management or regional monitoring plans, the project will participate in their development and implementation.

4.12 Environmental and Social Management and Monitoring Plan

An Environmental and Social Management and Monitoring Plan (ESMMP) was developed to guide implementation of the proposed mitigation measures in an effective manner to ensure sustainability of the project development throughout its life. The ESMMP summarizes the planned mitigation measures against the anticipated environmental impacts and the responsibility for its implementation and supervision including monitoring.

SOCIAL AND ENVIRONMENTAL BASELINE

5 ENVIRONMENTAL AND SOCIAL BASELINE

5.1 Introduction

The environmental and social baseline conditions in which the project will operate and in which impacts may be experienced are presented in this section. The description is designed to enable identification of particularly sensitive receptors and resources that could be vulnerable to impacts arising from the project.

The baseline information presented in this report focuses on both the Scheme Dam site and the Command area extent (9000 Ha) defined as the "Project Area" shown in Figure 2-2.

This section therefore includes:

- The area of influence; and
- Existing environmental and social baseline conditions.

5.2 Project area of influence

To identify, assess and manage potential environmental and social impacts, the potential area of influence (AOI) of the project has been defined. International Finance Corporation (IFC) Performance Standard (PS) 1, paragraph 8 (IFC 2012), defines the area of influence as encompassing the following components:

- "The area likely to be affected by:
  i. the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project;
  ii. impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or
  iii. indirect project impacts on biodiversity or on ecosystem services upon which affected communities' livelihoods are dependent.
- Associated facilities, which are facilities that are not funded as part of the project, would not have been constructed or expanded if the project did not exist and without which the project would not be viable. These will comprise of access roads to material borrow areas and project site, contractors camp site, waste management facilities, water supply and sanitation facilities, among others.
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly affected by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted."

The criteria for defining the AOI for each Valued Environmental and Social Component (VEC) takes account of the following, the:

- Permanent footprint associated with the project.
- Temporary footprint associated with construction and other sites, such as construction store, office and waste management facilities, borrow sites, etc.
- Area outside the footprint potentially affected by direct impacts such as noise and dust.

- Area potentially affected by indirect impacts such as villages and towns affected by in-migration of contractor workers (Table 5-22); and
- Area used for assessing cumulative impacts, which is defined as the areas where AOIs for the project and sources of cumulative impact VECs experience overlapping impacts, spatially and temporarily, from past, present, and future activities, including from associated facilities and third-party projects.

The study area for each VEC takes account of the AOI to understand the context in which the VECs exist, including trends and pressures on the condition of the VECs.

The AOI is different for the construction, operation and decommissioning phases of the projects. The AOI is also different for each VEC.

The AOI has been defined on a precautionary, realistic worst-case basis where there is uncertainty, with any assumptions clearly stated.

5.3 Project area – environmental context

5.3.1 Regional setting

The regional setting is defined as the Kanungu District in which the proposed Project facilities are located (Table 1-1).

5.3.2 Local setting

The local setting describes the receiving environment at the proposed sites of the project described in section 2.1.1 and 137.9 sq.km catchment area up to the dam site.

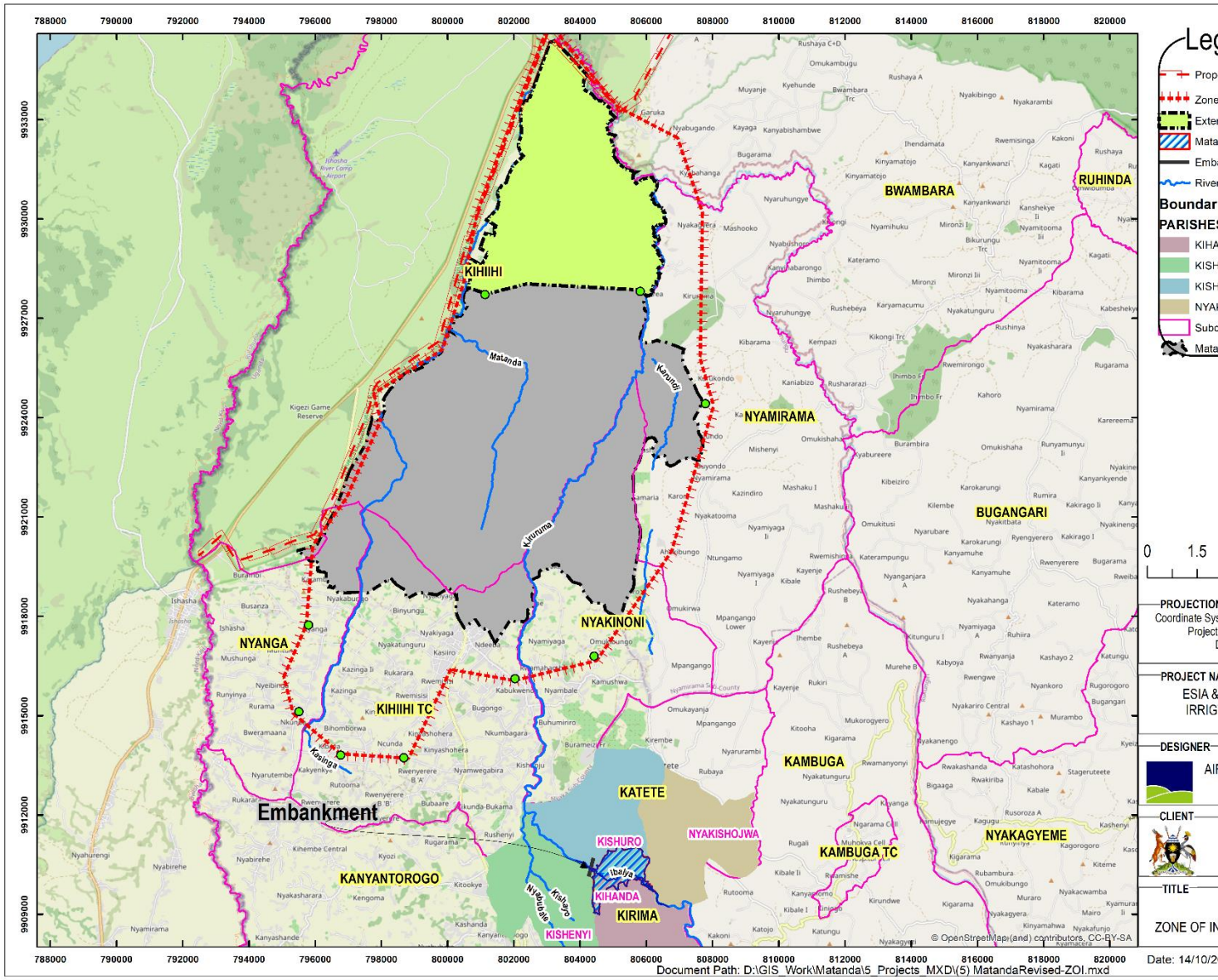
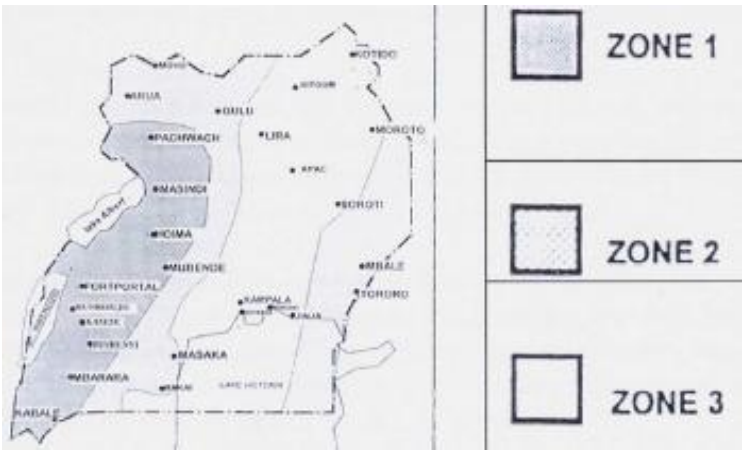


Figure 5-1 Project AOI location map

5.4 PHYSICAL ENVIRONMENTAL BASELINE

5.4.1 Seismology



The proposed site lies within zone 1 of the seismic zoning of Uganda, implying that there's a high risk of earthquake occurrence at the site (Seismic Code of Practice for Structural designs; UNBS, 1st Edition: June 2013).

Seismic/Dynamic analysis was considered in the design of the dam to determine the response of the dam to seismic forces. Simulations for earthquakes were done and the dynamic response of the dam structure determined. This response includes displacements, and both tensile and compressive stresses.

Return Period for Seisimic Analysis: According to current practice large dams have to be able to withstand the effects of the Maximum Design Earthquake (MDE) and the Probable Maximum Flood (PMF). These are the most severe events that could affect the safety of a dam, and they are considered to have a return period of several thousand years. Matanda was designed for PMF >10,000-year floods. The value of the return period corresponding to the respective PGA was obtained from Cheriberi & Yee (2022). For the Matanda dam site, the MDE-PGA = 0.15g used is associated with 10% exceedance probability for 50years.

5.4.2 Analysis of Climate Change Impacts on the Project

5.4.2.1 Global Circulation Model (GCMs) selection criteria

The updated Climate modelling for the Matanda Irrigation Scheme is work in progress and it will completed and available for the irrigation scheme before commencement of irrigation scheme operation. However, the data set used in this report is part of the Nile Basin Initiative dataset based on the climate change data downscaling conducted in 2019 from the CORDEX dataset (NBI, 2019). In the study, several criteria were used to guide “best” performing GCMs and assigned weights based on their performance for the different measures. These included: a) Independence measure; b) Historical overall skill performance assessment; c) whether a GCM can reproduce historical variability (both seasonal and annual); d) whether a GCM’s future projection consistent with other; and e) whether the GCM is able to reproduce extreme statistics (such as dry, wet, cold, warm) in historical dataset. The first realization, initialization, and physics (r1i1pi) of each of the GCM families were selected for this purpose giving a total of 34 GCMs for the analysis. More detailed explanation of the criteria is presented in the sections below.

Independence Weight Approach: The hypothesis behind the independence weight approach is that GCMs that come from the same “family” are considered “siblings” and may provide similar results in the historical retrospective run, and similar results potentially in the future. These GCMs may not be so much different from each other to be much more informative for future projection such that important future condition that decision makers interested in

may not be captured by these GCMs. When one tries to assign weight to each of the GCM projections, an approach that doesn't include this fact may unfairly weight higher a set of GCMs that are highly correlated. The independence weight approach is done by first calculating the Inter Model Distance (IMD) between each of the GCMs as well as observations.

Overall Skill Based weight: Skill weights are calculated based on each model's ability to reproduce historical observation in the form of seasonal climatological data.

Reproducing seasonal and annual variability: The third GCM section criterion is based on reproducing variability that was recorded in the historical data. Variability is defined as the coefficient of variation (both seasonal and annual). Similar to independence and skill-based weights, variability skill also used exponential based weighting scheme to identify how far a GCMs shall be downgraded if it did not produce the historical coefficient of variation compared to historical data.

Agreement to consensus weight: While the above criteria depend on historical data to assess a GCM skill, there is no guarantee that past performance may translate into future projection accuracy. On the other hand, future projections cannot be validated by how accurate they represent the future since that data is not available. The "truth centered" approach that says historical retrospective runs of GCMs are assumed to be sampled from a distribution that is centered on observation plus some error (skill weight is used for this measure) and future GCM projections are centered in the ensemble mean was used. This approach makes the ensemble mean to be a better predictor of the future than what a single GCM will be able to say. Under this assumption for the future, weights are then derived based on their distance from ensemble mean.

Reproducing extreme statistics: Extreme statistics include dry/wet condition and/or cold/warm for temperature. "Extreme" is typically defined as percentile of seasonal data, e.g., 10th percentile of rainfall data would constitute a dry condition that has a once in ten-year return period. Whereas the 90th percentile would correspond to a once in ten-year wet condition.

Downscaling and bias correction: GCMs have significant bias in their simulation of important climatic variables. Bias in GCMs is primarily a result of structural uncertainty that is tied to their inability to describe a known process accurately given the resolution of the model being simulated. Bias correction tries to inject local variability into an otherwise much smoother outputs of the parent GCMs. Bias corrections are done for two specific times of a GCM run: retrospective (historical) run and future scenario run. In doing so, the implicit assumption is that a GCM will carry the same bias that it showed in the past into the future. After bias correction, retrospective GCM outputs will have the same statistical characteristics as the observed historical data albeit different values in their time sequences. The Quantile Mapping (QM) method was used to correct projection biases. The QM method is a non-parametric bias correction method and is generally applicable for all possible distributions of precipitation without any assumption on precipitation distribution. It can effectively correct bias in the mean, standard deviation and wet-day frequency as well as quantiles.

Analysis: This section presents a comparative analysis of the historical rainfall compared to the projected rainfall averages based on the selected models and downscaled data.

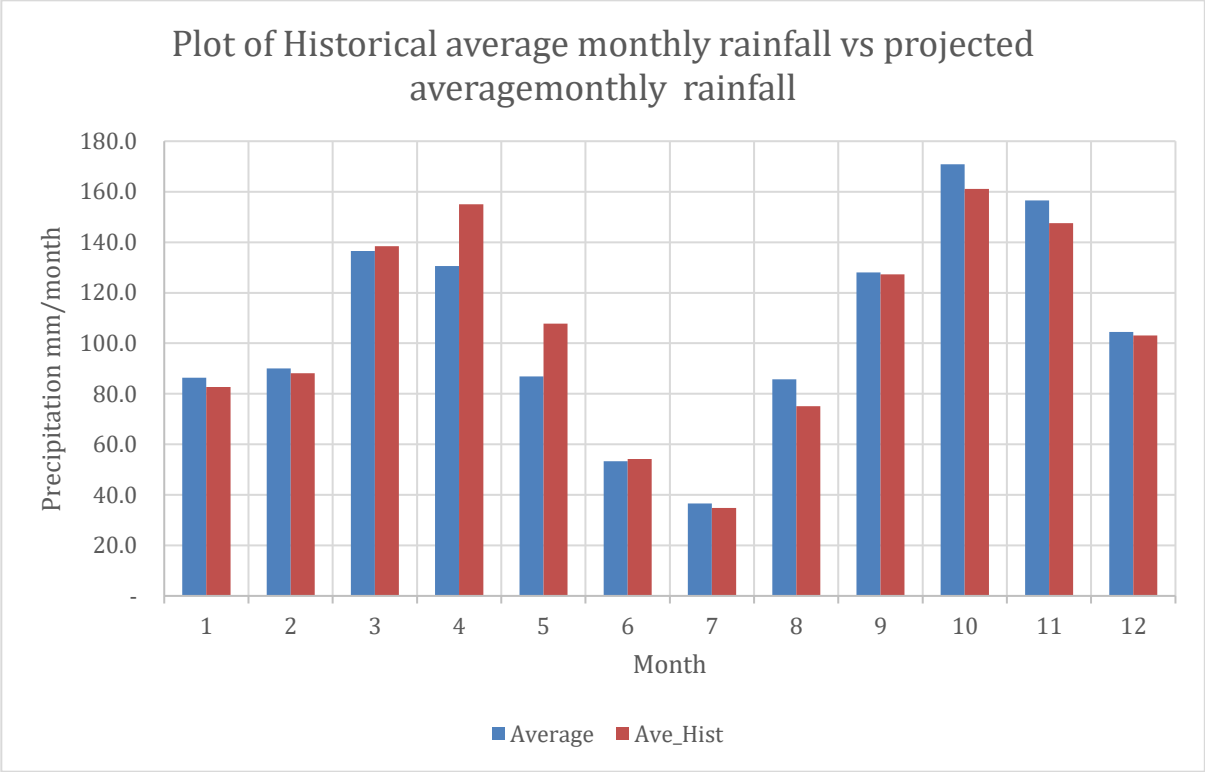


Figure 2:Comparative analysis of historical and projected monthly average precipitation

Table: Percentage change in precipitation between the historical and projected precipitation

Month	Average	Ave_Hist	%Change
1	86.4	82.7	3%
2	90.1	88.1	2%
3	136.6	138.5	-2%
4	130.6	155.1	-23%
5	86.8	107.7	-20%
6	53.3	54.2	-1%
7	36.6	34.8	2%
8	85.8	75.1	10%
9	128.1	127.2	1%
10	170.9	161.1	9%
11	156.5	147.5	8%
12	104.4	103.1	1%
Average	105.5	106.3	-1%

From the comparison of the historical rainfall to the projected future rainfall, there is an estimated decrease in rainfall of about 1%. However, there is a markable decrease in rainfall during the rainy season of March to June which is compensated by an increase rainfall in the rest of the months. It can be concluded that the impact of climate change on the project will be negligible.

5.4.2.2 Analysis using HadCM3 and ECHAM5 Models

The climate change impact analysis was done using the climate change analysis tool developed by the Nile Equatorial Subsidiary Action program (NELSAP) 2013. The tool uses four scenarios described by the IPCC's special report on emission scenarios, SRES A1, A2, B1, and B2. These scenarios are modeled using two Global circulation models HadCM3 and ECHAM5 to predict future climatic parameters of wind, temperature, pressure, precipitation, and others.

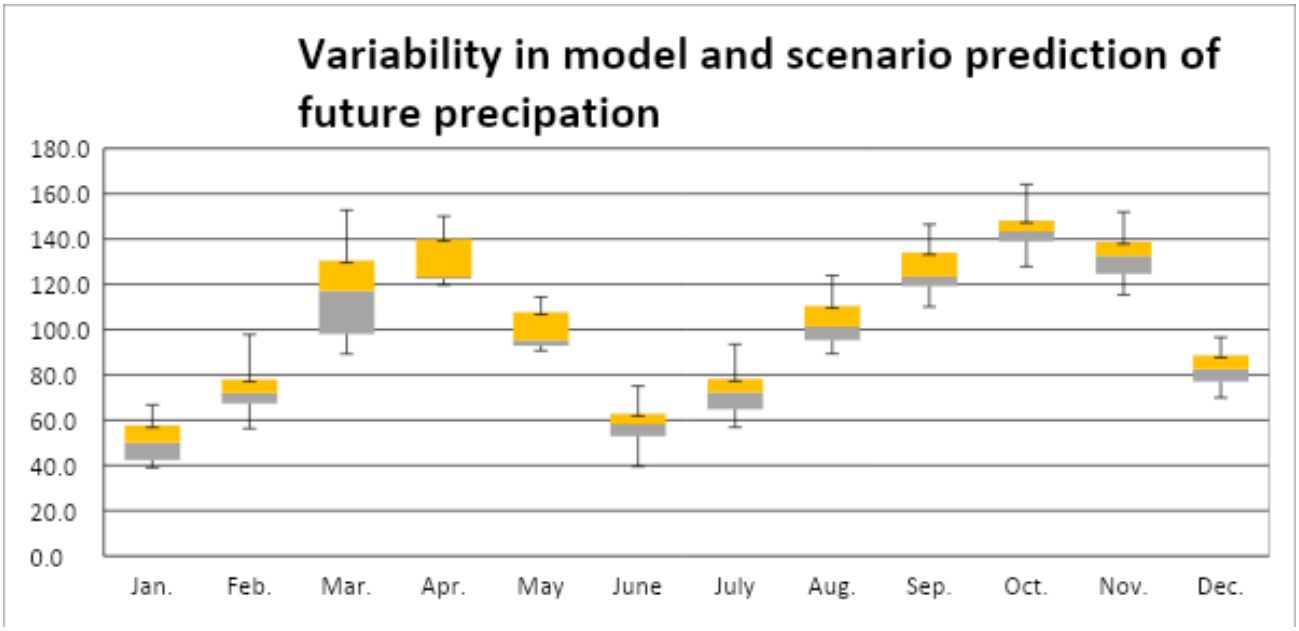


Figure 5-3**:** *Box plot of climate model and scenario analysis of future precipitation*

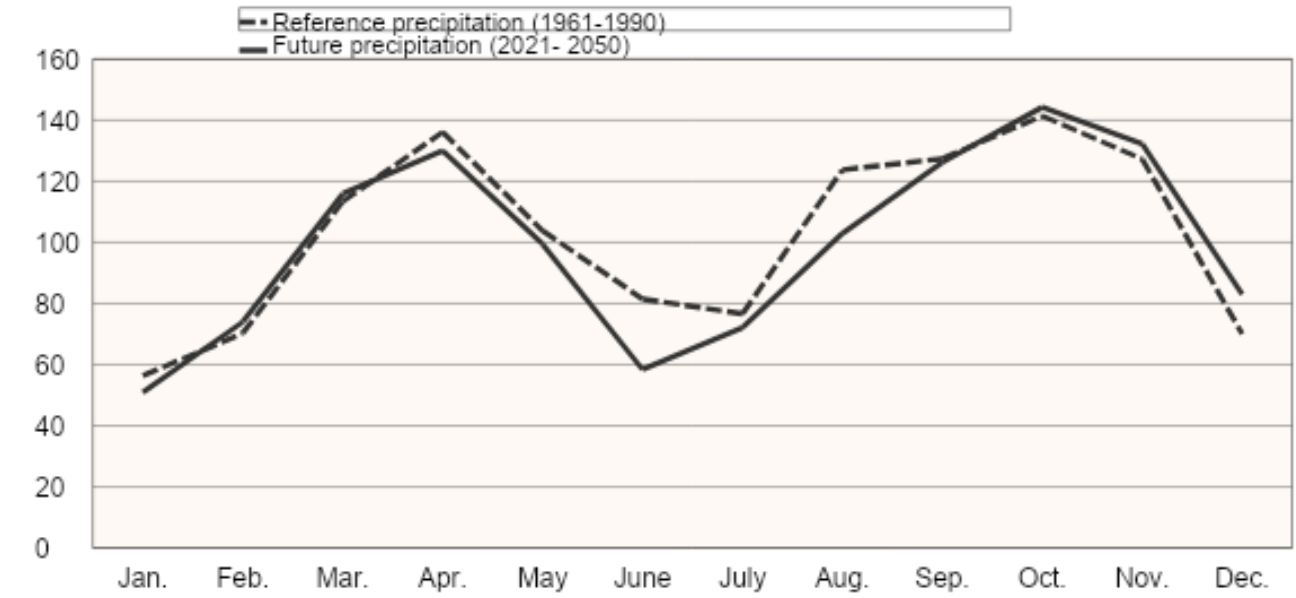


Figure 5-4**:** *Comparison of reference and future Average Monthly Precipitation*

The models predict an average reduction in annual precipitation of about 3% mainly impacting the dry periods of the year. It can be stated that climate change will result in a slight reduction in the future precipitation mainly occurring during the dry months. The 3% variability is within the parameter sensitivity analysis range of such projects which is about 10%. It can therefore be concluded that climate change will not have adverse impacts on the project.

5.4.3 Topography

Kanungu District lies in the fringes of the western Rift valley. The Northern end forms part of the Rift valley with undulating plains features (Figure 5-5). The middle part (Sub-Counties of Rugyeyo and Kirima) comprises flat-topped hills with gentle sloping sides and broad valleys. These hills gradually increase in height to the highlands of Rutenga with Burimbi peak of Mafuga being the highest at 82222 ft (2503 m) above sea level with some parts of Kihihi Sub County lying in the fringes of the western Eastern Africa Rift valley. A narrow and higher accentuated relief to the south forms a watershed between Lake Victoria drainage and Northern drainage. The terrain in Matanda is relatively flat as you move towards the proposed Matanda Irrigation Scheme command area.

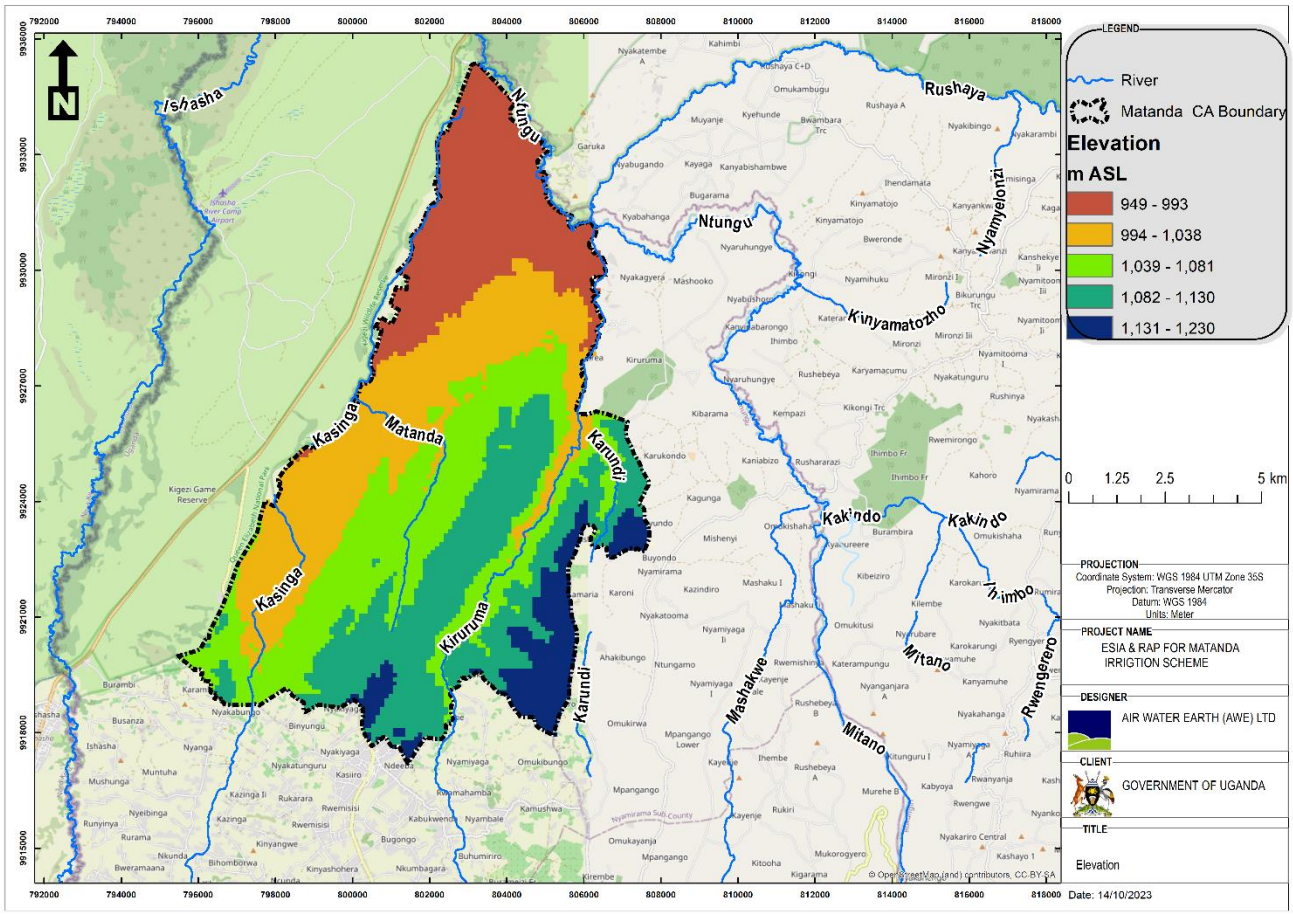


Figure 5-5**:** Topographical map of the proposed Matanda Irrigation Scheme command area.

Topographical data used to draw the river's cross section is composed of a topographic survey completed in April and May 2021. Areas covered are the riverbed and the floodplain in some areas.

Figure 5-6*: Project area, flood inundation with reservoir*

5.4.4 Geology and Soils

The location of the project within the rift valley has a large impact on the area geology and subsequently the soils. Geology is dominated by the Basement Complex and the Karagwe-Ankolean forms that are of Precambrian origin. Rift valley sediments, which are sedimentary in nature, dominate in the vicinity of the dams while metamorphic rocks, including undifferentiated gneisses, argillites and phyllites, dominate in the higher parts of the catchment. As a result sandy soils and sandy loams are predominant on the lower slopes. Sandy clays, sandy loams and clay mixes dominate on the upper slopes. Sand mining is a common activity in the areas just downstream of the proposed site.

The most common types of soils are grayish brown sandy loams and reddish-brown sand (especially in Kihihi and Nyamirama sub counties-Figure 5-7). See Appendix I for elaborate soil description. The soils consist of;

- **Yellow - red sandy, clay loams soils** varying from dark gray to dark, which is mainly derived from granite, gneissic and sedimentary rocks. They occur on gently undulating - hilly topography.
- **Brown - yellow clay loams** with laterite horizon with a variety of dark brown to dark grayish brown. These occur on flat ridge tops or as of undulating topography.
- **Light - gray- white mottled black loamy soils** with laterite horizon ground, structure-less loamy sands. They are mainly found on the lower and bottom.

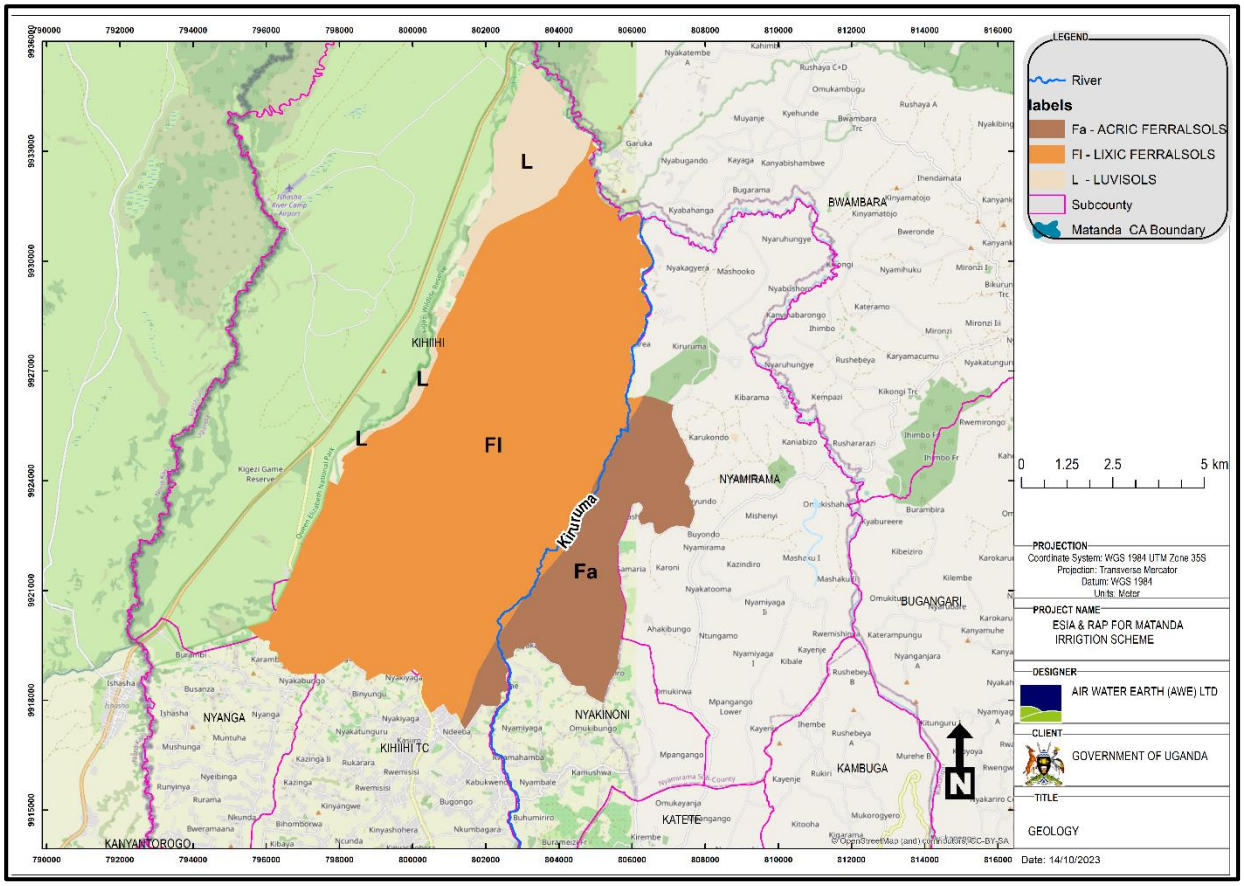


Figure 5-7*: Geology around the proposed Matanda Irrigation Scheme Area*

The upstream dam site consists mainly of weathered and consolidated rocks up to 40m depths (of investigation). See Figure 5-8

Figure 5-8: Rock outcrop (and samples of drilled rock) at Upstream Dam Location

5.4.5 Climate

Kanungu district is located in Climate Zone Cw which receives over 1222 mm/year of mean annual rainfall though it is not evenly spread and receives much less rainfall in winter than in the summer, between the months of March - May and September – December days. Kanungu region lies 1610m above sea level. Uganda can be divided into four main Agro-Ecological Zones (AEZ):

- **High altitude zone**: characterized by temperate zone crops in some areas of Ankole, Kigezi, Mbale, Sabel, Toro and in West Nile.
- **Pastoral arid to semi-arid zones**: areas that are characterized by pastoral systems and are generally in the East of Ankole, Karamoja and west of Masaka.
- **Northern and eastern short grassland zones**: characterized by mixed farming systems such as cotton-finger millet and short grassland.
- **Southern and western tall grassland zones**: characterized by mixed farming systems, such as perennial and annual crops and tall grassland.

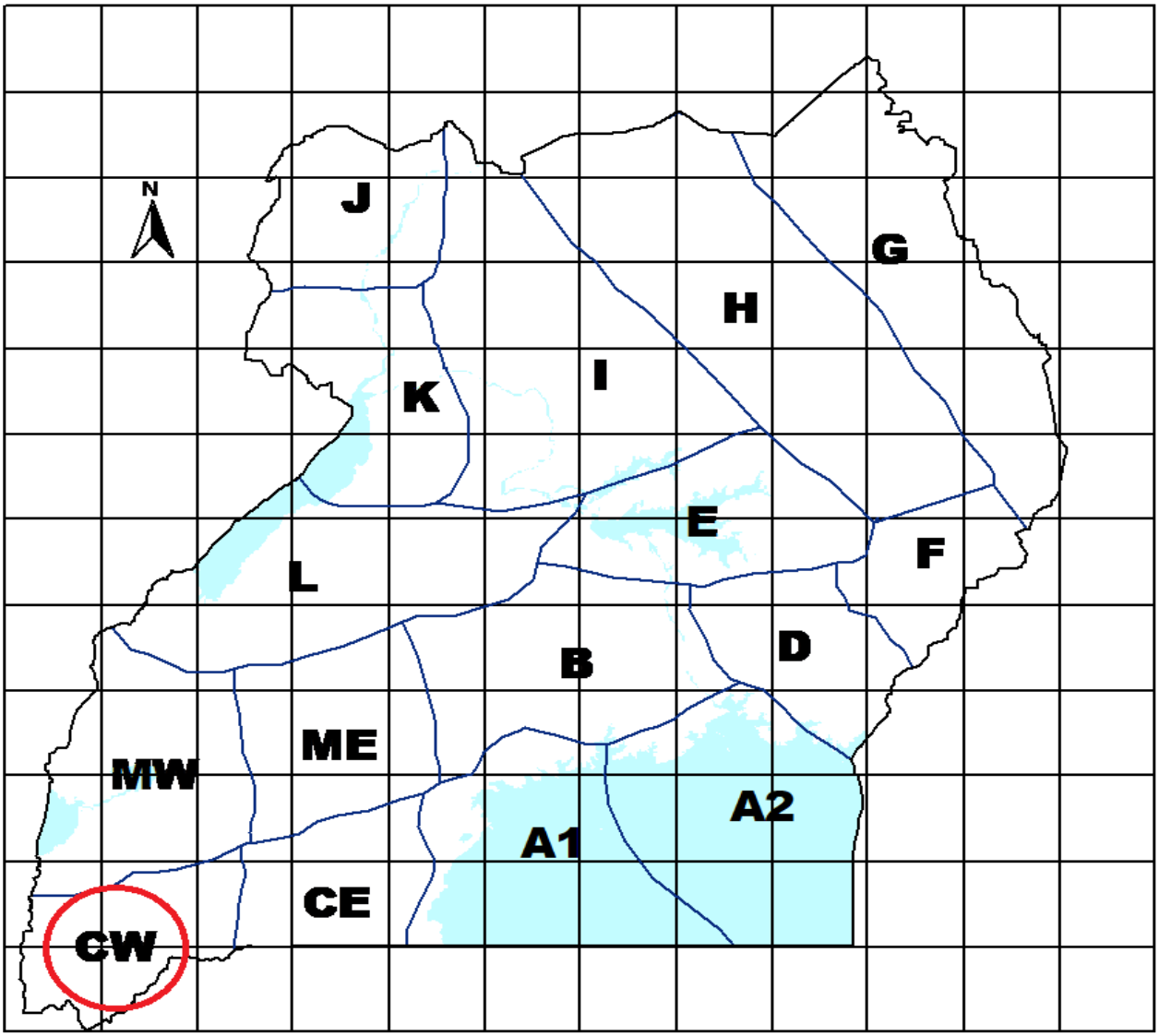


Figure 5-9: Climate Zones in Uganda (Hydro-climatic Study, 2001)

Zone	Annual and its zonal variability	Main rainy seasons	Main dry seasons	Evaporation versus rainfall
CW	Average of 1120 mm.	Two rainy seasons, main season September to December with peak in October/November and secondary season March to May with a peak in April.	Main dry season is June to August, secondary dry season is January and February.	Evaporation > rainfall by a factor of ~ 3 during the dry months, June to August. During the rainy seasons' rainfall is greater and or equal to evaporation.

Project Area Rainfall Profile

There are many stations in region many of which are far away (Bushenyi and Mbarara) and not expected to be representative of the climate conditions on site. There are at least 14 rainfall stations located close to the proposed dam sites, many of which are currently not operational based on records at Uganda National Meteorological Authority (UNMA).

Table 5-1 shows the key rainfall statistics at the stations whileTable 5-1 shows the details of the stations including the number of years with complete records. Some of the stations, like Nyakibale, Rukungiri, etc., have relatively long records which can be used as a basis for the hydrological assessments.

Table 5-1 Key rainfall statistics at all rainfall stations

Station Name	Rainfall statistics (mm)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual rainfall
Nyakibale	77.5	71.8	102.6	153.9	116.7	45.1	41.6	99.4	149.3	142.3	161.8	115.7	1,277.8
Kanungu	67.6	61.0	113.0	153.7	148.8	77.7	66.1	125.4	164.8	158.0	141.3	88.7	1,366.2
Rukungiri Disp	86.0	67.3	114.4	122.4	81.3	45.1	39.5	92.1	136.0	143.1	166.4	114.1	1,207.8
Bugangari Disp	70.3	72.6	100.3	150.2	103.9	60.9	41.8	98.4	124.4	138.0	161.1	112.9	1,234.8
Burema	55.5	50.2	124.5	146.8	155.5	74.8	65.6	96.6	191.2	148.1	148.0	104.4	1,361.3
Rulind Swamp	61.3	79.8	94.7	109.7	81.6	24.6	26.2	81.5	95.1	89.3	136.5	118.7	999.1
Kihihi Tractor Hire	55.8	61.8	88.0	122.3	145.7	59.0	42.9	86.6	136.4	167.5	122.2	78.4	1,166.6
Kitahulira Forest	64.4	85.1	121.8	188.2	139.8	66.2	52.7	122.9	185.6	189.4	193.6	81.2	1,490.9
Kaniabizo	50.3	48.4	93.9	139.6	137.4	56.7	49.4	93.1	192.3	185.7	177.4	52.4	1,276.5
Kisizi Health Ctre	44.4	65.5	139.4	167.6	141.3	49.9	33.4	70.3	162.8	97.6	80.1	71.4	1,123.6
Mafuga Forest	75.4	86.3	119.3	164.7	114.9	44.1	31.2	83.3	128.1	123.9	144.9	100.2	1,216.4
Kashambya	31.9	68.5	81.4	105.4	81.9	18.5	15.1	61.3	137.4	131.0	123.5	118.0	973.8
Nyarushanje	63.4	77.9	97.1	128.4	80.8	41.3	43.8	82.4	104.6	117.5	134.0	83.1	1,054.4
Ruhiza Forest Stn	79.7	111.2	156.7	180.1	115.6	48.0	50.0	89.0	186.6	167.3	176.5	95.1	1,455.8

Table 5-2: Rainfall stations and number of years with complete records

Station ID	Station Name	Latitude (deg)	Longitude (deg)	No years
9029000	Nyakibale	-0.817	29.933	20
9029002	Kanungu	-0.900	29.767	19
9029004	Rukungiri Dispensary	-0.783	29.933	20
9029005	Bugangari Dispensary	-0.733	29.833	28
9029014	Burema	-0.850	29.750	6
9029015	Rulind Swamp Inlet	-0.983	29.967	9
9029017	Kihihi Tractor Hire	-0.750	29.683	12
9029020	Kitahulira Forest	-0.983	29.700	11
9029027	Kaniabizo	-0.683	29.800	3
9129005	Kisizi Health Centre	-1.000	29.933	2
9129006	Mafuga Forest	-1.050	29.883	26
9129016	Kashambya	-1.050	29.967	5
9129018	Nyarushanje	-1.000	29.983	17
9129020	Ruhiza Forest Station	-1.050	29.783	21

Figure 5-10 shows the variation of daily rainfall for six sites with the longest records, while Figure 5-11 shows the variation of their mean monthly rainfall. From a visual inspection of Figure 5-14, the variability of rainfall is consistent for all stations with a bimodal variation clear in all and practically the same months for wet and dry seasons.

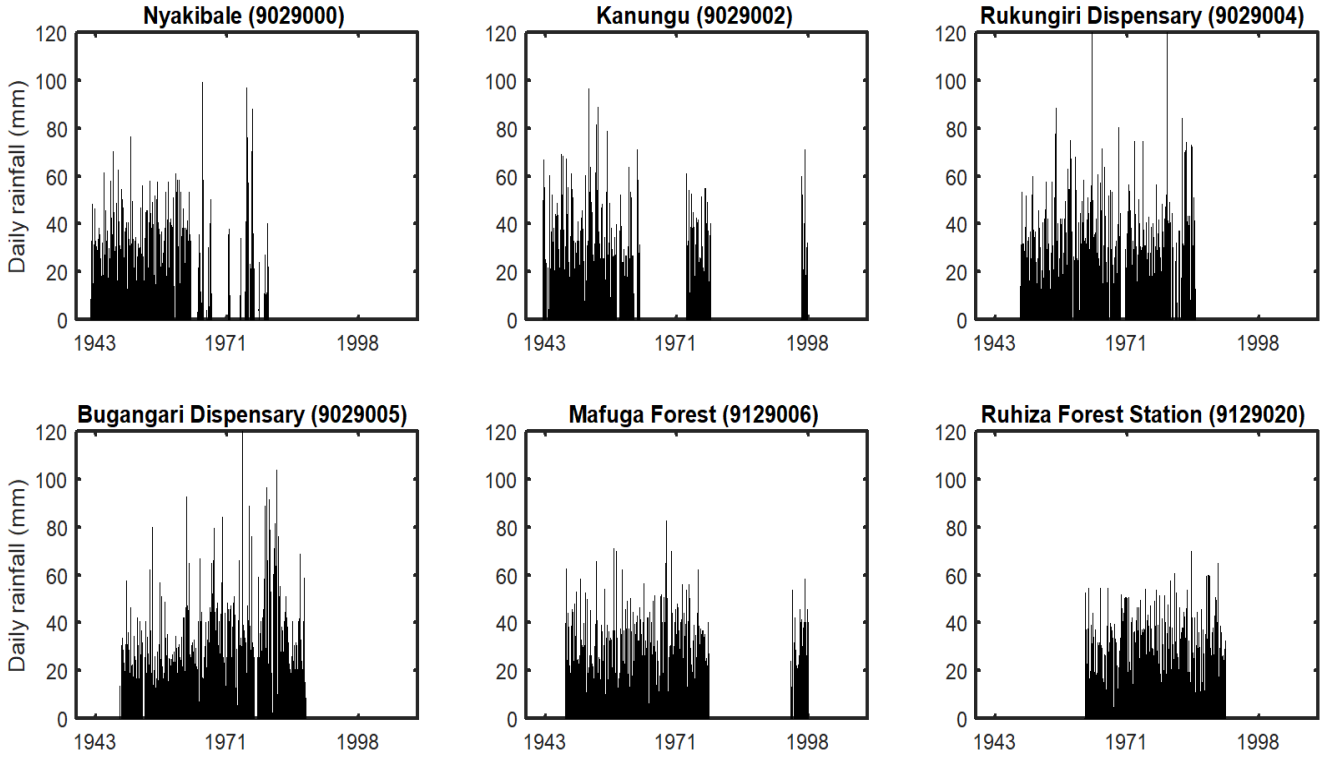


Figure 5-10:: Variation of daily rainfall at selected sites (mm)

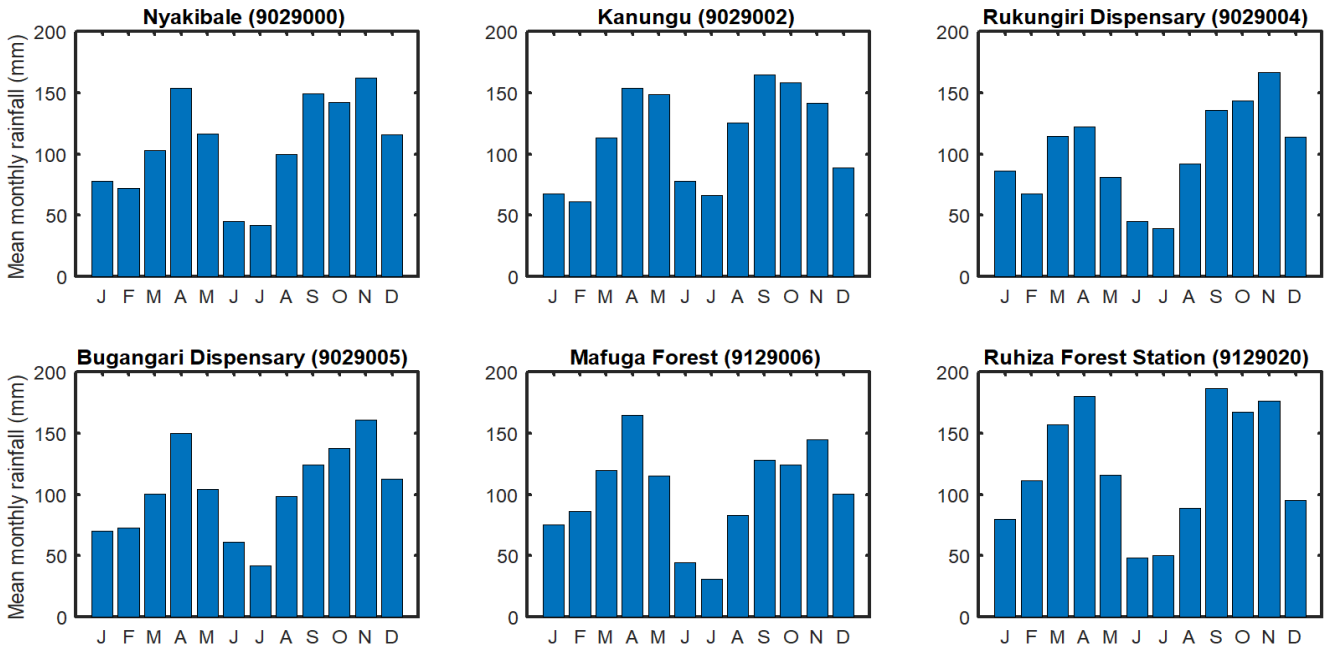


Figure 5-11: *Variation of mean monthly rainfall at selected sites (mm)*

The climate in Kanungu District is tropical. The location is classified as **Aw** by Köppen and Geiger. **Aw** represents Tropical wet savanna climate; with the driest month having precipitation less than 60 mm. **A** is a tropical climate group based on precipitation and temperature patterns and **w** is a wet savanna seasonal precipitation subgroup. The temperature averages at 18.9 °C and Precipitation at 1222 mm. The driest month is July, with 37 mm of rain. With an average of 151 mm, the most precipitation falls in November. February is the warmest month of the year. The temperature in February averages 19.2 °C. June has the lowest average temperature of the year. It is 18.6 °C. There is a difference of 114 mm of precipitation between the driest and wettest months. During the year, the average temperatures vary by 0.6°C. Rainfall is important to the life of the people of the district as they depend on rain fed agriculture, its timing and intensity creates an impact on the agricultural productivity in the district, however rainfall is no longer reliable and difficult to predict; making it difficult for farmers to plan for the agricultural seasons properly.

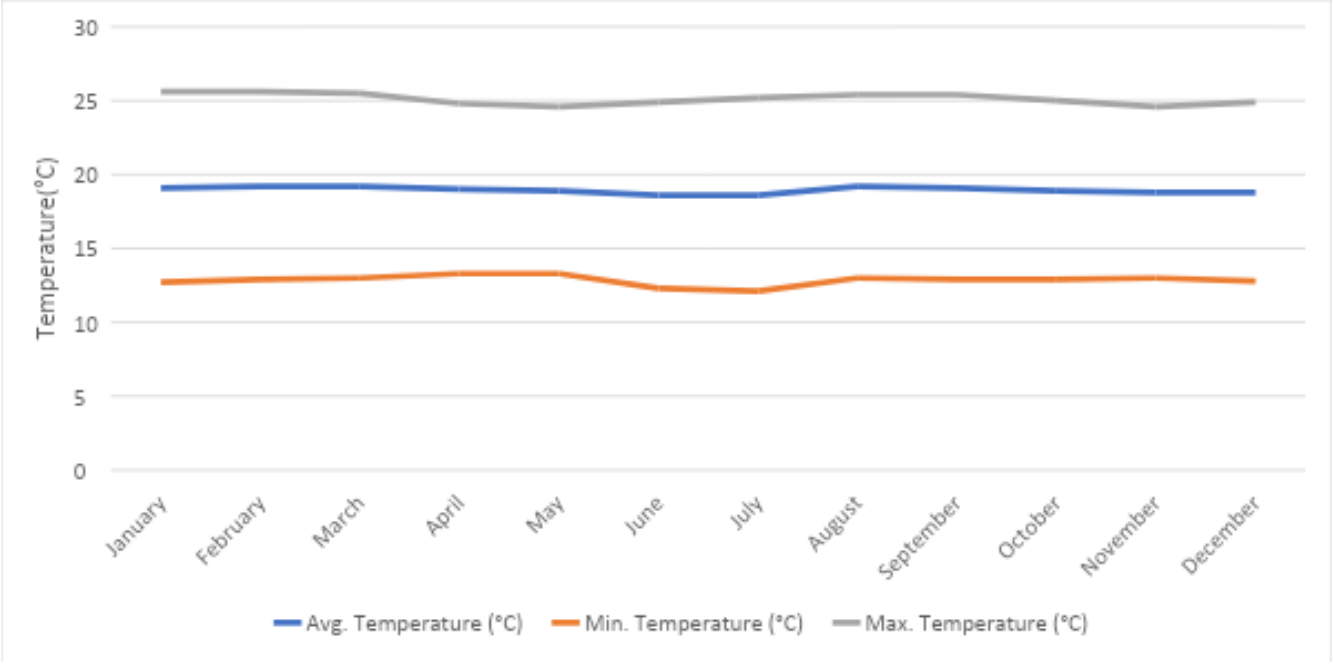


Figure 5-12: Temperature in Kanungu

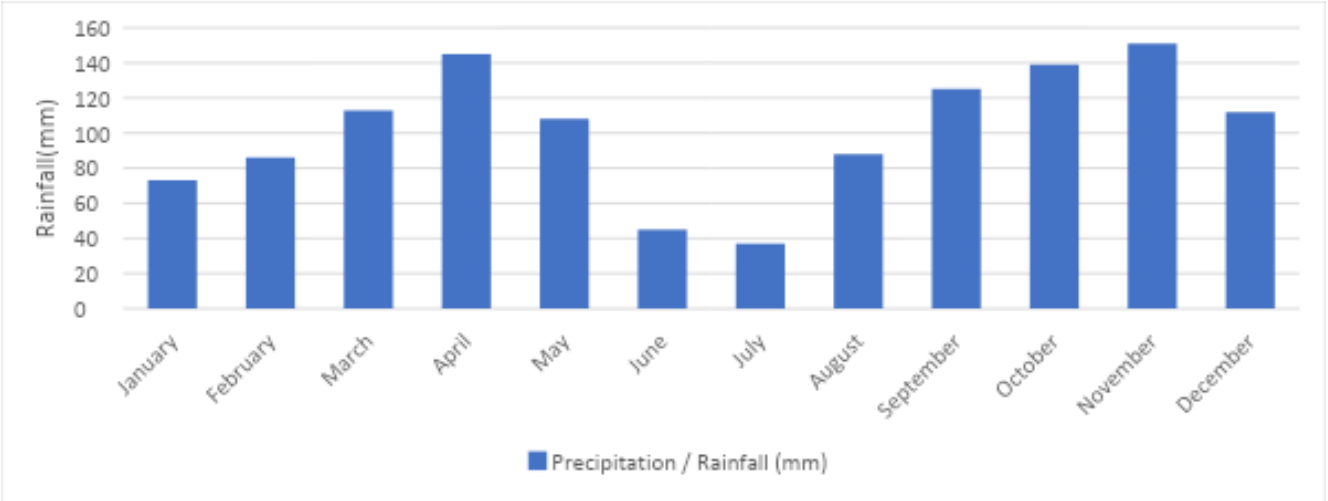


Figure 5-13: Precipitation in Kanungu

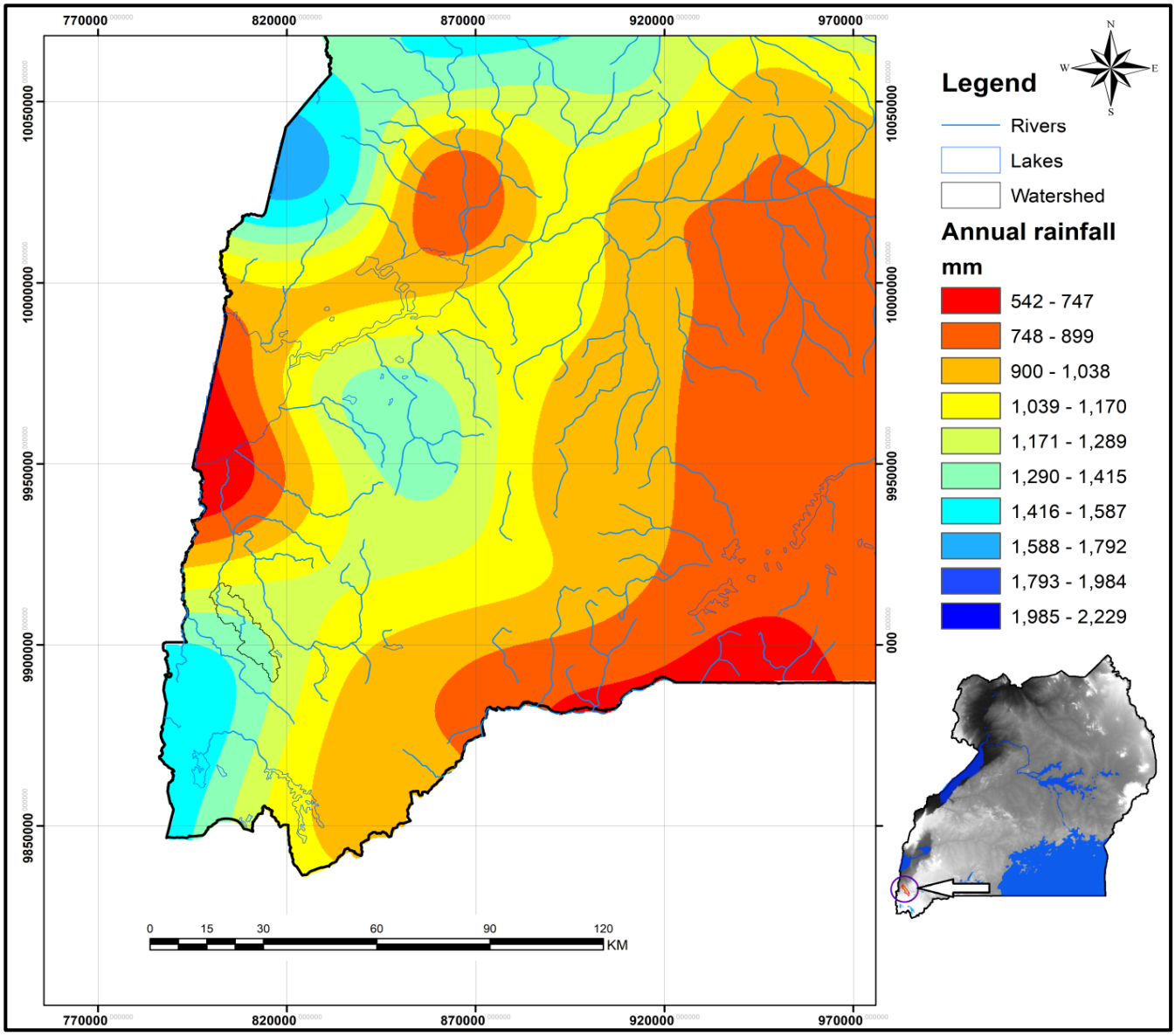


Figure 5-14: Rainfall variation in southwestern Uganda (Hydroclimatic Study, 2001) LANDCOVER

5.4.6 Ambient Air Quality

From the active air sampling method described in sub-section 4.4.2 the results of the baseline ambient air quality monitoring at proposed site are summarized in Table 5-3 and Figure 5-18. The facts below provide a perspective to the air quality monitoring results presented in this section:

- NEMA's air quality standards, published in 2006, currently exist only in draft form (Appendix G).
- These standards contain columns for acceptable limits for concentrations of air pollutants in both ambient air and point source exhaust streams. No mention is made in reference to area sources and volume sources.

Table 5-3 Maximum Dust measures (PM concentration) at different sampling locations in Scheme command area

		PM 2.5 (mg/m3)				PM 10 (mg/m3)				
ID	**Location Details**	**Min**	**Max**	**Avg**	**NEMA/ WHO24 -hour AQG**	**Min**	**Max**	**Avg**	**NEMA/WHO24- hour AQG**	**Remarks on Results**
1	Ishasha Sector Headquaters Barracks	0.010	0.036	0.023	**0.025**	0.013	0.086	0.049	**0.05**	Particulate matter emission was attributed to dusty roads
2	Bukorwe Primary School	0.012	0.018	0.015	**0.025**	0.018	0.063	0.041	**0.05**	Particulate matter emission was attributed to dusty roads
3	Bokorwe Catholic Church (Nyanga Subcounty	0.012	0.019	0.016	**0.025**	0.019	0.094	0.057	**0.05**	Particulate matter emission was attributed to dusty roads
4	Kazinga Mosque	0.014	0.064	**0.039**	**0.025**	0.027	0.660	**0.344**	**0.05**	Particulate matter emission was attributed to dusty roads
5	Kazinga Trading Centre	0.011	0.032	0.022	**0.025**	0.014	0.281	**0.148**	**0.05**	Particulate matter emission was attributed to dusty roads
6	Karambi Trading Centre (Miam)	0.013	0.018	0.016	**0.025**	0.021	0.117	0.069	**0.05**	Particulate matter emission was attributed to dusty roads
7	Kyenteija Church of Uganda	0.017	0.041	**0.029**	**0.025**	0.026	0.343	**0.185**	**0.05**	Particulate matter emission attributed to blowing wind

		PM 2.5 (mg/m3)				PM 10 (mg/m3)				
ID	Location Details	Min	Max	Avg	NEMA/ WHO24 -hour AQG	Min	Max	Avg	NEMA/WHO24-hour AQG	Remarks on Results
8	Kameme Primary School	0.021	0.036	**0.028**	**0.025**	0.026	0.117	0.072	**0.05**	Particulate matter emission attributed to blowing wind
9	Kameme Trading Centre	0.010	0.060	**0.035**	**0.025**	0.029	0.50	**0.26**	**0.05**	Particulate matter emission was attributed to dusty roads
10	Global Christs Mission	0.011	0.051	**0.031**	**0.025**	0.02	0.067	0.044	**0.05**	Particulate matter emission attributed to blowing wind
11	Kameme Trading Centre	0.021	0.054	**0.028**	**0.025**	0.026	0.076	0.051	**0.05**	Particulate matter emission was attributed to dusty roads
12	Burimano Church of Uganda	0.025	0.028	**0.026**	**0.025**	0.028	0.041	0.035	**0.05**	Particulate matter emission was attributed to dusty roads
13	Burimano Trading Centre/ Mosque	0.024	0.029	**0.026**	**0.025**	0.026	0.041	0.033	**0.05**	Particulate matter emission was attributed to dusty roads
14	Matanda Primary School	0.011	0.026	0.018	**0.025**	0.024	0.062	0.043	**0.05**	Particulate matter emission was attributed to dusty roads
15	Matanda H/C III	0.015	0.036	0.025	**0.025**	0.021	0.16	**0.09**	**0.05**	Particulate matter emission attributed to blowing wind
16	Matanda Refugee Transit Centre	0.023	0.039	**0.031**	**0.025**	0.028	0.084	0.056	**0.05**	Particulate matter emission attributed to blowing wind

		PM 2.5 (mg/m3)				PM 10 (mg/m3)				
ID	Location Details	Min	Max	Avg	NEMA/ WHO24 -hour AQG	Min	Max	Avg	NEMA/WHO24-hour AQG	Remarks on Results
17	Rushoroza Seed Secondary School	0.012	0.035	0.023	**0.025**	0.028	0.06	0.044	**0.05**	PM matter emission was attributed to dusty roads
18	ST Charles Catholic Church (Group Farm A CELL)	0.013	0.024	0.018	**0.025**	0.021	0.102	**0.062**	**0.05**	Particulate matter emission attributed to blowing wind
19	Kibimbiri P/S (Group Farm A Cell)	0.010	0.028	0.019	**0.025**	0.012	0.112	**0.116**	**0.05**	Particulate matter emission was attributed to dusty roads
20	Group Farm A Trading Centre	0.017	0.031	0.024	**0.025**	0.09	0.143	0.044	**0.05**	Particulate matter and dusty roads
21	Honey Moslem Primary School	0.015	0.028	0.023	**0.025**	0.026	0.062	0.051	**0.05**	Particulate matter emission attributed to blowing wind
22	Rushoroza Primary School (Kibimbiri A)	0.011	0.025	0.018	**0.025**	0.029	0.072	0.058	**0.05**	Particulate matter and dusty roads
23	St Erminio High School/ Rushoroza Catholic Church	0.012	0.043	0.027	**0.025**	0.031	0.086	**0.301**	**0.05**	Particulate matter emission attributed to blowing wind

		PM 2.5 (mg/m3)				PM 10 (mg/m3)				
ID	**Location Details**	**Min**	**Max**	**Avg**	**NEMA/ WHO24 -hour AQG**	**Min**	**Max**	**Avg**	**NEMA/WHO24- hour AQG**	**Remarks on Results**
24	Rushoroza Trading Centre	0.011	0.035	0.023	**0.025**	0.041	0.561	**0.251**	**0.05**	Particulate matter and dusty roads
25	Rwerere Trading Centre	0.015	0.120	**0.068**	**0.025**	0.047	2.276	**1.162**	**0.05**	Particulate matter emission attributed to blowing wind
26	Nyakahita primary school	0.030	0.291	**0.161**	**0.025**	0.031	1.031	**0.531**	**0.05**	Particulate matter and dusty roads
27	Kyenyabutongo Trading Centre	0.025	0.048	**0.037**	**0.025**	0.036	0.577	**0.307**	**0.05**	Particulate matter emission attributed to blowing wind
28	Kyenyabutongo C.O.U & P/S	0.017	0.043	0.003	**0.025**	0.027	0.872	**0.449**	**0.05**	Particulate matter and dusty roads
29	St.Emmanuel Church And Health Centre II	0.013	0.033	0.023	**0.025**	0.029	0.058	**0.095**	**0.05**	Particulate matter emission attributed to blowing wind
30	Kibimbiri C.O.U P/S	0.012	0.034	0.018	**0.025**	0.028	0.103	0.065	**0.05**	Particulate matter and dusty roads
31	Kibimbiri Trading Centre	0.012	0.076	0.020	**0.025**	0.018	0.172	**0.095**	**0.05**	Particulate matter emission attributed to blowing wind
32	Kyakatarangi P/SI	0.014	0.032	0.022	**0.025**	0.014	0.139	**0.077**	**0.05**	Particulate matter and dusty roads

		PM 2.5 (mg/m3)				PM 10 (mg/m3)				
ID	**Location Details**	**Min**	**Max**	**Avg**	**NEMA/ WHO24 -hour AQG**	**Min**	**Max**	**Avg**	**NEMA/WHO24- hour AQG**	**Remarks on Results**
33	Kiramira Catholic Church	0.011	0.025	0.003	**0.025**	0.027	0.043	0.035	**0.05**	Particulate matter emission attributed to blowing wind
34	Queen Elizabeth Primary School and Kashojwa C.O.U	0.019	0.022	0.019	**0.025**	0.012	0.16	**0.086**	**0.05**	Particulate matter and dusty roads
35	Bushere Church of Uganda	0.012	0.032	0.023	**0.025**	0.022	0.042	0.032	**0.05**	Particulate matter emission attributed to blowing wind
36	Bushere Health Centre II	0.018	0.042	0.015	**0.025**	0.02	0.028	0.024	**0.05**	Particulate matter and dusty roads
37	Bushere Primary School	0.011	0.027	0.024	**0.025**	0.014	0.058	0.036	**0.05**	Particulate matter and dusty roads
38	Matanda II Church of Uganda	0.014	0.032	0.003	**0.025**	0.10	0.072	**0.086**	**0.05**	Particulate matter and dusty roads

From the table above, almost half of the average particulate matter assessed values for both $PM_{2.5}$ and PM_{10} were above the national and international limits of 0.025g/m3 and 0.050 mg/m3. For example, at Kazinga Mosque (0.039mg /m^3), (0.344mg/m^3), Kazinga Trading Centre (0.148mg/m^3), Kyenteija Church of Uganda (0.029 mg/m^3), (0.185 mg/m^3), Kameme Primary School (0.028 mg/m^3), Kameme School (0.035 mg/m^3), (0.026 mg/m^3), Global Christs Mission (0.031 mg/m^3), Kameme Trading Centre (0.028 mg/m^3), Burimano Church of Uganda (0.026 mg/m^3), Matanda H/C III (0.09 mg/m^3), Matanda Refugee Transit Centre (0.031 mg/m^3), ST Charles Catholic Church (Group Farm A CELL) (0.062 mg/m^3), Kibimbiri Parents Primary School (Group Farm A Cell) (0.116 mg/m^3), St Erminio High School/ Rushoroza Catholic Church(0.301 mg/m^3), Rushoroza Trading Centre (0.251 mg/m^3), Rwerere Trading Centre(0.068 mg/m^3), (1.162 mg/m^3), Nyakahita primary school (0.161 mg/m^3), (0.531 mg/m^3), Kyenyabutongo

Trading Centre (0.037 mg/m^3), (0.307 mg/m^3), Kyenyabutongo C.O.U & P/S (0.449 mg/m^3), St.Emmanuel Church And Health Centre II (0.095 mg/m^3), Kibimbiri Trading Centre 0.095 mg/m^3), Kyakatarangi Primary School 0.077 mg/m^3), Queen Elizabeth Primary School and Kashojwa C.O.U 0.086 mg/m^3), and Ishasha Sector Headquaters Barracks & UWA Offices Bukorwe 0.029 mg/m^3), which were slightly above the limits. Particulate matter levels were mainly influenced by air circulation/blowing wind, Particulate matter emission was attributed to dusty roads that come from a variety of sources such as cars, trucks, dusty roads from unpaved roads, stone crushing at the time of assessment. More so, air quality assessment was carried out during the dry season with blowing winds and dusty road, or un paved road along the entire project area, this is in line with Venkatram et al. (2007), findings which states that, the most important factors driving the dispersion of traffic-generated emissions are wind speed and wind direction. Also, PM readings within the project area is attributed to high temperatures and strong winds causing resuspension of particulate matter as well as increasing the dispersion rates from the unpaved roads at the time of assessment.

Inference from Measurements: These measurements indicate a reasonably clean environment with respect to air quality**.** At all locations, TSP levels conformed to the draft national limit of 0.3 mg/m^3 and gas monitoring equipment did not detect CO, NO_2, and SO_2, combustible gases. These measurements indicate a generally pristine environment with respect to air quality.

Table 5-4: Air quality measurements

ID	**Location Details**	**NO_2 (mg/m3)**	**CO (mg/m3)**	**SO2 (mg/m3)**
		0.2 ppm / 1hr)	**9.0 ppm / 8hr**	**10µg/m3 (12hr)**
1	Ishasha Sector Headquaters Barracks &UWA Offices Bukorwe	Min: 0.056 Ave: 0.081 Max: 0.106	Min: 0.04 Ave 3.46 Max: 6.88	Min: 0.02 Ave: 0.09 Max: 0.15
2	Bukorwe Primary School	Min: 0.000 Ave: 0.029 Max: 0.059	Min: 0.01 Ave: 0.19 Max: 0.36	Min: 0.01 Ave: 0.13 Max: 0.24
3	Bokorwe Catholic Church (Nyanga Subcounty	Min: 0.031 Ave: 0.049 Max: 0.068	Min: 0.01 Ave: 1.56 Max: 2.50	Min: 0.10 Ave: 0.11 Max: 0.12
4	Kazinga Mosque	Min: 0.001 Ave: 0.021 Max: 0.041	Min: 0.00 Ave: 0.81 Max: 1.62	Min: 0.00 Ave: 0.03 Max: 0.06
5	Kazinga Trading Centre	Min: 0.015 Ave: 0.062 Max: 0.109	Min: 3.47 Ave: 4.53 Max: 5.59	Min: 0.01 Ave: 0.01 Max: 0.19
6	Karambi Trading Centre (Miam)	Min: 0.033 Ave: 0.057 Max: 0.081	Min: 2.87 Ave: 3.54 Max: 4.21	Min: 0.02 Ave: 0.07 Max: 0.12

ID	Location Details	NO_2 (mg/m3)	CO (mg/m3)	SO_2 (mg/m3)
7	Kyenteija Church of Uganda	Min: 0.002 Ave: 0.007 Max: 0.011	Min: 0.04 Ave: 0.19 Max: 0.37	Min: 0.00 Ave: 0.31 Max: 0.61
8	Kameme Primary School	Min: 0.003 Ave: 0.053 Max: 0.102	Min: 0.00 Ave: 0.00 Max: 0.00	Min: 0.00 Ave: 0.01 Max: 0.02
9	Kameme Trading Centre	Min: 0.000 Ave: 0.014 Max: 0.028	Min: 0.01 Ave: 2.47 Max: 4.93	Min: 0.00 Ave: 0.29 Max: 0.58
10	Global Christs Mission	Min: 0.000 Ave: 0.000 Max: 0.000	Min: 0.00 Ave: 0.40 Max: 0.80	Min: 0.00 Ave: 0.00 Max: 0.00
11	Kameme Trading Centre	Min: 0.000 Ave: 0.000 Max: 0.000	Min: 0.02 Ave: 2.57 Max: 5.12	Min: 0.00 Ave: 0.00 Max: 0.00
12	Burimano Church of Uganda	Min: 0.000 Ave: 0.000 Max: 0.000	Min: 0.00 Ave: 0.11 Max: 0.21	Min: 0.00 Ave: 0.00 Max: 0.00
13	Burimano Trading Centre/ Mosque	Min: 0.000 Ave: 0.000 Max: 0.000	Min: 0.04 Ave: 4.49 Max: 8.94	Min: 0.02 Ave: 0.12 Max: 0.23
14	Matanda Primary School	Min: 0.016 Ave: 0.035 Max: 0.053	Min: 0.06 Ave: 0.09 Max: 0.11	Min: 0.02 Ave: 0.09 Max: 0.15
15	Matanda H/C III	Min: 0.004 Ave: 0.015 Max: 0.026	Min: 0.06 Ave: 4.67 Max: 9.28	Min: 0.01 Ave: 0.02 Max: 0.04
16	Matanda Refugee Transit Centre	Min: 0.010 Ave: 0.027 Max: 0.043	Min: 0.20 Ave: 2.65 Max: 5.10	Min: 0.02 Ave: 0.19 Max: 0.35
17	Rushoroza Seed Secondary School	Min: 0.009 Ave: 0.021 Max: 0.033	Min: 0.10 Ave: 1.14 Max: 2.26	Min: 0.02 Ave: 0.11 Max: 0.20
18	ST Charles Catholic Church (Group Farm A CELL)	Min: 0.013 Ave: 0.018 Max: 0.023	Min: 0.15 Ave: 2.6 Max: 8.25	Min: 0.02 Ave: 0.01 Max: 0.35
19	Kibimbiri Parents Primary School (Group Farm A Cell)	Min: 0.011 Ave: 0.032 Max: 0.052	Min: 0.01 Ave: 2.57 Max: 5.12	Min: 0.01 Ave: 0.05 Max: 0.09
20	Group Farm A Trading Centre	Min: 0.002 Ave: 0.009 Max: 0.016	Min: 0.03 Ave: 3.11 Max: 6.18	Min: 0.00 Ave: 0.02 Max: 0.04

ID	Location Details	NO_2 (mg/m3)	CO (mg/m3)	SO_2 (mg/m3)
21	Honey Moslem Primary School	Min: 0.003 Ave: 0.009 Max: 0.015	Min: 0.07 Ave: 3.59 Max: 7.12	Min: 0.00 Ave: 0.02 Max: 0.03
22	Rushoroza Primary School (Kibimbiri A)	Min: 0.000 Ave: 0.009 Max: 0.018	Min: 0.01 Ave: 1.88 Max: 3.75	Min: 0.00 Ave: 0.00 Max: 0.00
23	St Erminio SSS/ Rushoroza Catholic Church	Min: 0.000 Ave: 0.006 Max: 0.012	Min: 0.01 Ave: 1.57 Max: 3.12	Min: 0.00 Ave: 0.00 Max: 0.00
24	Rushoroza Trading Centre	Min: 0.001 Ave: 0.001 Max: 0.018	Min: 0.02 Ave: 2.58 Max: 5.13	Min: 0.01 Ave: 0.03 Max: 0.06
25	Rwerere Trading Centre	Min: 0.084 Ave: 0.088 Max: 0.090	Min: 1.30 Ave: 1.79 Max: 2.50	Min: 0.00 Ave:0.04 Max:0.08
26	Nyakahita primary school	Min: 0.058 Ave: 0.096 Max: 0.152	Min: 0.00 Ave: 0.00 Max: 0.00	Min: 0.05 Ave: 0.04 Max: 0.03
27	Kyenyabutongo Trading Centre	Min: 0.103 Ave: 0.151 Max: 0.202	Min: 0.03 Ave: 0.04 Max: 0.06	Min:0.00 Ave:0.03 Max:0.64
28	Kyenyabutongo C.O.U & Primary School	Min: 0.011 Ave: 0.036 Max: 0.061	Min: 0.01 Ave: 0.72 Max: 1.42	Min: 0.04 Ave: 0.07 Max: 0.11
29	St.Emmanuel Church And Health Centre II	Min: 0.015 Ave: 0.033 Max: 0.050	Min: 0.05 Ave: 0.2 Max: 0.35	Min: 0.00 Ave: 0.03 Max: 0.07
30	Kibimbiri C.O.U Primary School	Min: 0.013 Ave: 0.024 Max: 0.034	Min: 0.01 Ave: 0.11 Max: 0.21	Min: 0.00 Ave: 0.03 Max: 0.06
31	Kibimbiri Trading Centre	Min: 0.009 Ave: 0.03 Max: 0.051	Min: 0.07 Ave: 1.29 Max: 2.50	Min: 0.06 Ave: 0.07 Max: 0.8
32	Kyakatarangi Primary School	Min: 0.083 Ave: 0.109 Max: 0.134	Min: 0.00 Ave: 3.82 Max: 7.63	Min: 0.03 Ave: 0.11 Max: 0.19
33	Kiramira Catholic Church	Min: 0.000 Ave: 0.018 Max: 0.036	Min: 0.06 Ave: 0.28 Max: 0.45	Min: 0.01 Ave: 0.13 Max: 0.25
34	Queen Elizabeth P/S and Kashojwa C.O.U	Min: 0.009 Ave: 0.037 Max: 0.056	Min: 0.09 Ave: 4.19 Max: 8.20	Min: 0.08 Ave: 0.24 Max: 0.32

ID	Location Details	NO_2 (mg/m3)	CO (mg/m3)	SO_2 (mg/m3)
35	Bushere Church of Uganda	Min: 0.010 Ave: 0.066 Max: 0.112	Min: 0.06 Ave: 2.64 Max: 5.16	Min: 0.13 Ave: 0.03 Max: 0.34
36	Bushere Health Centre II	Min: 0.013 Ave: 0.038 Max: 0.062	Min: 0.04 Ave: 0.09 Max: 0.15	Min: 0.01 Ave: 0.04 Max: 0.06
37	Bushere Primary School	Min: 0.010 Ave: 0.023 Max: 0.036	Min: 1.30 Ave: 1.90 Max: 2.50	Min: 0.02 Ave: 0.06 Max: 0.10
38	Matanda II Church of Uganda	Min: 0.015 Ave: 0.033 Max: 0.050	Min: 0.05 Ave: 0.2 Max: 0.35	Min: 0.00 Ave: 0.03 Max: 0.07
Source: Air Quality Standards for Ambient Air and Point Source Emissions, (NEMA, 2006)				

At all the 38 sites assessed, Nitrogen dioxide (NO_2) average readings ranged from 0.003 mg/m^3 to 0.151mg/m^3, Carbon monoxide average readings ranged from 0.02 mg/m^3 to 4.49 mg/m^3 and Sulphur dioxide (SO_2) average readings ranged from 0.01 mg/m^3 to 0.31 mg/m^3. Average readings for Nitrogen dioxide, Carbon monoxide, and Sulphur dioxide at all the 38 sites sampled did not vary a lot i.e., NO_2 (0.003 mg/m^3 to 0.151mg/m^3), CO (0.02 mg/m^3 to 4.49 mg/m^3) and Sulphur dioxide SO_2 (0.01 mg/m^3 to 0.31 mg/m^3). This was attributed to the different emission sources due to emissions from running diesel engines especially along the project area and vehicular smoke from the running engines like boda-boda and vehicles at the time of the assessment. In general, the concentration of gasses varies depending on the time of the day due to variations in humidity and temperature.

5.4.7 Ambient Noise

From the baseline noise measurements conducted (Sub-section 4.4.3); inferences were made on project area baseline noise, with comparison against the standards provided in the National Noise Standards and Regulations (Appendix H). The results of the baseline noise measurements recorded are presented in Table 5-4 and Figure 5-19.

Table 5-5: Project area baseline noise monitoring results

I.D	Location Details	Cycle Start	Cycle Finish	LAFmin (dB)	LAFmax (dB)	LAeq (dB)	Notes
NOISE LIMIT (dB(A) LAeq)				**85**	**85**	**85**	
N1	Ishasha Sector Barracks &UWA Offices	8:00	10:00	34.2	80.6	**57.4**	Vehicular traffic. Human conversations. Chirping birds.
N2	Bukorwe P/S	11:00	13:00	49.9	110.7	**82.3**	Heavy vehicular traffic. Human conversations. Chirping birds.
N3	Bokorwe Catholic Church	13:00	15:30	46.9	90.5	**65.4**	Vehicular traffic. Human conversations.
N4	Kazinga Mosque	15:45	17:45	53.8	92.7	**69.2**	Vehicular traffic. Human conversations.
N5	Kazinga T/C	17:55	19:55	36.6	84.4	**57.2**	Vehicular traffic. Human conversations.
N6	Karambi T/C	8:00	10:00	36.7	76.2	**54.6**	Vehicular traffic. Human conversations. Chirping birds.
N8	Kyenteija COU	11:00	13:00	53.9	83.7	**66.1**	Vehicular traffic. Human conversations. Chirping birds.
N9	Kameme P/S	13:00	15:30	48.5	49.4	**81.7**	Heavy Vehicular traffic. Human conversations. Chirping birds. Rustling leaves.
N10	Kameme T/C	15:45	17:45	45.3	80.4	**59.4**	Vehicular traffic. Playing children. Chirping birds.
N11	Global Christs Mission	17:55	19:55	44.8	79.6	**62.1**	Vehicular traffic. Human conversations. Distant public address system.
N12	Kameme T/C	8:00	10:00	53.4	92.6	**67.4**	Vehicular traffic. Human conversations. Chirping birds.
N13	Burimano COU	11:00	13:00	48.8	88.2	**65.2**	Vehicular traffic. Human conversations. Chirping birds.
N14	Burimano T/C Mosque	13:00	15:30	40.3	86.5	**62.8**	Vehicular traffic. Human conversations. Chirping birds.
N15	Matanda P/S	15:45	17:45	53.2	83.1	**67.3**	Vehicular traffic. Human conversations. Chirping birds.
N16	Matanda H/C III	17:55	19:55	44.5	85.5	**62.1**	Vehicular traffic. Human conversations. Chirping birds.

I.D	Location Details	Cycle Start	Cycle Finish	LAFmin (dB)	LAFmax (dB)	LAeq (dB)	Notes
N17	Matanda Refugee Transit Centre	8:00	10:00	53.5	93.9	**68.3**	Vehicular traffic. Human conversations.
N18	Rushoroza SSS	11:00	13:00	51.7	93.7	**67.1**	Vehicular traffic. Human conversations.
N19	ST Charles Catholic Church	13:00	15:30	42.9	84.3	**61.6**	Vehicular traffic. Human conversations.
N20	Kibimbiri Parents P/S	15:45	17:45	51.7	95.9	**71.5**	Vehicular traffic. Human conversations. Chirping birds.
N21	Group Farm A T/C	17:55	19:55	50.4	93.6	**76.8**	Vehicular traffic. Human conversations. Chirping birds.
N22	Honey Moslem P/S	8:00	10:00	51.7	95.2	**80.4**	Heavy Vehicular traffic. Human conversations. Chirping birds. Rustling leaves.
N23	Rushoroza P/S	11:00	13:00	49.1	87.9	**64.7**	Vehicular traffic. Playing children. Chirping birds.
N24	Rushoroza Catholic Church	13:00	15:30	47.6	70.6	**51.3**	Vehicular traffic. Human conversations. Distant public address system.
N25	Rushoroza T/C	15:45	17:45	30.4	87.8	**64.5**	Vehicular traffic. Human conversations. Chirping birds.
N26	Rwerere T/C	17:55	19:55	46.7	86.6	**71.4**	Vehicular traffic. Human conversations. Chirping birds.
N27	Nyakahita P/S	8:00	10:00	43.9	91.2	**78.7**	Vehicular traffic. Human conversations. Chirping birds.
N28	Kyenyabutongo T/C	11:00	13:00	48.6	83.1	**66.7**	Vehicular traffic. Human conversations. Chirping birds.
N29	Kyenyabutongo C.O.U & P/S	13:00	15:30	39.3	84.2	**63.3**	Vehicular traffic. Human conversations.
N30	St.Emmanuel Church H/C II	15:45	17:45	40.3	80.4	**59.1**	Vehicular traffic. Human conversations.
N31	Kibimbiri C.O.U	8:00	10:00	35.9	74.9	**56.6**	Vehicular traffic. Human conversations.
N32	Kibimbiri T/C	11:00	13:00	48.6	83.1	**66.7**	Vehicular traffic. Human conversations. Chirping birds.
N33	Kyakatarangi P/S	13:00	15:30	36.9	84.2	**59.9**	Vehicular traffic. Human conversations. Chirping birds.

I.D	Location Details	Cycle Start	Cycle Finish	LAFmin (dB)	LAFmax (dB)	LAeq (dB)	Notes
N34	Kiramira Catholic Church	15:45	17:45	44.5	82.4	**62.1**	Vehicular traffic. Human conversations. Chirping birds. Rustling leaves.
N35	Queen Elizabeth P/S and Kashojwa C.O. U	17:55	19:55	41.6	83.6	**60.3**	Vehicular traffic. Playing with children. Chirping birds.
N36	Bushere COU	8:00	10:00	40.3	73.7	**55.4**	Vehicular traffic. Human conversations. Distant public address system.
N37	Bushere H/C II	11:00	13:00	46.8	85.8	**66.3**	Vehicular traffic. Human conversations. Chirping birds.
N38	Bushere P/S	13:00	15:30	50.2	77.3	**64.2**	Vehicular traffic. Human conversations. Chirping birds.
Applicable noise Limits are as prescribed for the First Schedule of General Environment in the National Environment (Noise Standards and Control) Regulations, 2003							

Comparing with both the Ugandan and international standards, the equivalent continuous sound pressure level the noise emission results at all sampled sites were all within the permissible noise limits as prescribed in the National Environment (Noise Standards and Control) Regulations, 2003, for Maximum Permissible Noise Levels (i.e.,75 for commercial areas, 85 dBA for industrial setting and for the General Environment as described in the National Environment (Noise Standards and Control) Regulations, 2003.

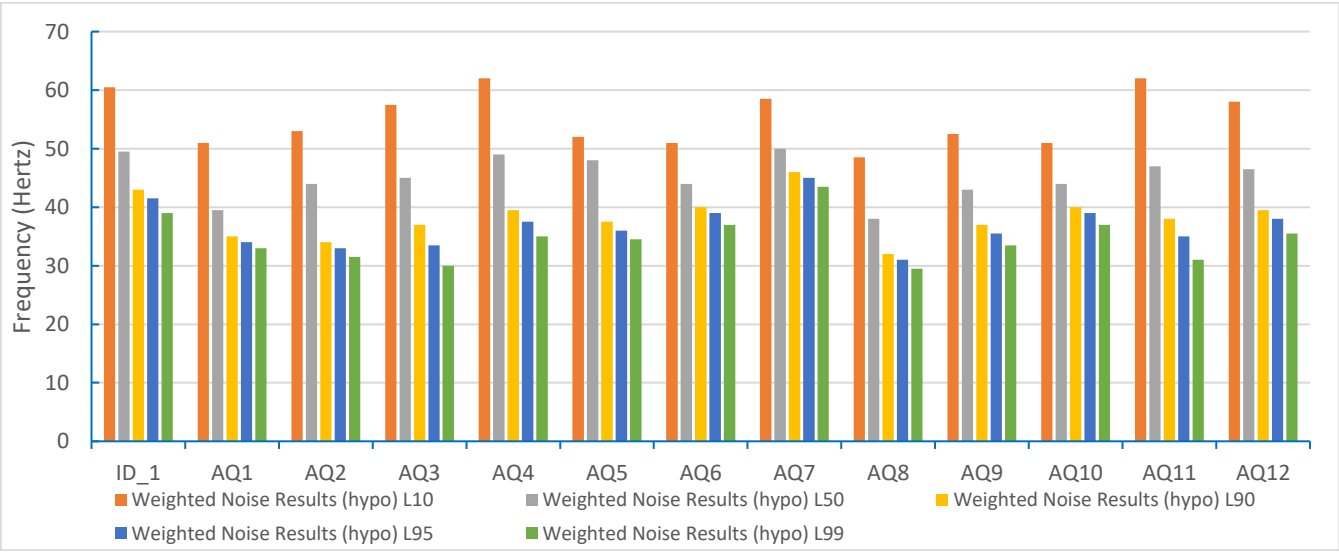


Figure 5-15: Noise frequency at different sampling locations in the proposed scheme command area

Inference from measurements:

The measurements highlighted indicate that in some locations of the project area along local roads, the baseline day-time noise levels already exceed that in the NEMA standards.

L50 is the noise level exceeded 50% of the time. It is statistically the mid-point of the noise readings and L90 is the level exceeded for 90% of the time. For 90% of the time, the noise level is below 55dBA which is the standard for an environment that is mixed residential, commercial and entertainment. From the Figure 5-20, the command area is considered good and noise free with its primary non-point source of noise being the vehicles traveling through the village.

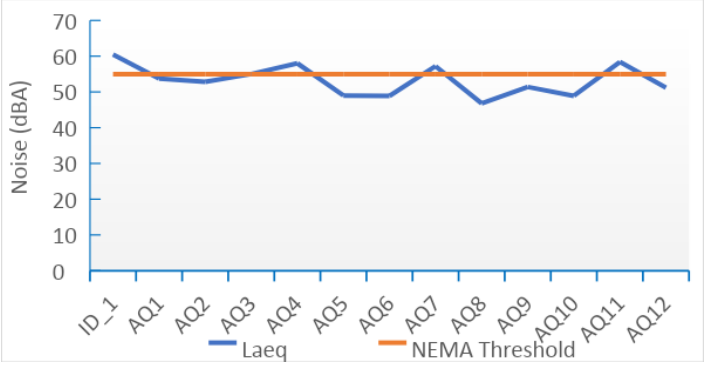


Figure 5-16: Noise levels against National Standards

5.4.8 Ground Vibrations

The human body is an excellent detector of vibrations and the human body senses ground vibrations at levels far below those that could cause damage. The complex time history recordings of the compression waves, shear waves and Rayleigh waves of which the latter is recorded by means of ground peak particle acceleration, peak particle velocity or peak particle displacement velocity (PPV), is simplified to one value based on the vector sum. The PPV is the measure for quantifying blast vibrations, as the velocity is approximately correlated to both building damage and annoyance levels to people. The unit that the PPV is recorded in is mm/s. The human body can detect PPV on the order of 0.2 mm/s with clearly perceptible levels of 1.0 mm/s. The PPV to cause cosmetic or structural damage to ordinary buildings is in the range of 5.0 to 50.0 mm/s (ISO10137 of 1992, British Standards BS7385 1993). The threshold level for cosmetic damage to residential construction is in the range of 12.0–50.0 mm/s and frequency dependent. The human response and annoyance to blast vibrations is aggravated by secondary noises such as walls and furniture rattling.

Vibrations, like noise, require a source, transmission path and a receiver. Vibrations are perceived when the distortion of a medium by a wave causes the excitation of a surface or structure. Currently, there are no national standards for vibrations. The interpretation of the acquired primary cannot, therefore, be authoritatively interpreted in a regulatory context. Measurement of these levels is still an important part of the monitoring activities during the pipeline construction phase where the nearby receptors might be affected. To put above baseline vibration values in context, BSI British Standards (BS 5228-2:2009): Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration, was used to evaluate and interpret the acquired data. In this Standard, peak particle velocity (PPV) in millimeters per second (mm/s) is the chosen indicator of both perceptibility and the risk of damage to structures. BS 7385-1 and BS 7385-2 provide guidance on measurement, evaluation of effects on buildings, and damage levels, and are based upon use of the PPV. Human and structural response to different vibration levels is influenced by distance between source(s) and receptor, ground type; which acts as transport medium, and duration

of the vibration intervals. The likelihood of adverse comments occurring from construction receptors is used to evaluate the likely severity of effect.
Table 5-6 summarises the effects that can be caused by various levels of ground vibrations.

Table 5-6: Effects that can be caused by various levels of ground vibrations

Vibration PPV (mm/s)	**Effect**
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

From the ground vibrations method described in Section 4.4.4, the results of the baseline ground vibrations are presented in Table 5-7. Currently, there are neither national nor WHO/IFC standards for vibrations.

Table 5-7: Vibration levels at for the different measurement locations within the proposed irrigation scheme command area

Location	***Seismic Readings**				**Air mic reading (dB)**	**Remarks**
	Axis	R	T	V		
VQ1	Peak (mm/s)	0.3	0.3	0.3	94.0 dB	Vehicular traffic
	Frequency (Hz)	0.1	0.0	0.1	37.9 Hz	
VQ2	Peak (mm/s)	0.3	0.4	0.1	95.9 dB	Vehicular traffic
	Frequency (Hz)	0.2	0.0	0.1	0.0 Hz	
VQ3	Peak (mm/s)	0.3	0.3	0.3	102.8 dB	Vehicular traffic
	Frequency (Hz)	0.1	0.0	0.0	11.3 Hz	
VQ4	Peak (mm/s)	0.4	0.1	0.3	97.5 dB	Vehicular traffic. Vicinity of planned reservoir.
	Frequency (Hz)	12.3	4.0	9.4	1.1 Hz	
VQ5	Peak (mm/s)	0.3	0.3	0.1	95.9 dB	Vehicular traffic
	Frequency (Hz)	0.1	0.0	0.0	60.2 Hz	
VQ6	Peak (mm/s)	0.3	0.3	0.3	94.0 dB	Vehicular traffic
	Frequency (Hz)	0.0	0.2	0.0	0.0 Hz	
VQ7	Peak (mm/s)	0.2	0.3	0.3	95.9 dB	Vehicular traffic
	Frequency (Hz)	0.0	0.0	0.1	0.5 Hz	
VQ8	Peak (mm/s)	0.3	0.3	0.3	94.0 dB	Vehicular traffic
	Frequency (Hz)	0.0	0.0	0.0	0.5 Hz	
VQ9	Peak (mm/s)	0.4	0.4	0.3	104.9 dB	Vehicular traffic
	Frequency (Hz)	0.0	0.0	0.0	41.0 Hz	
VQ10	Peak (mm/s)	0.4	0.5	0.3	91.5 dB	Vehicular traffic
	Frequency (Hz)	0.0	0.0	0.0	0.0 Hz	
VQ11	Peak (mm/s)	0.3	0.4	0.3	101 dB	Vehicular traffic
	Frequency (Hz)	0.0	0.0	0.0	2.7 Hz	
VQ12	Peak (mm/s)	0.5	0.6	0.4	91.5 dB	Vehicular traffic
	Frequency (Hz)	0.0	0.0	0.0	1.5 Hz	

From measurement data, baseline ground vibration levels ranged between 0.1 and 0.5 mm/s, which according to British Standard BS 5228-2:2009, code of practice for noise and vibrations control on open construction sites- part 2: vibrations might be just perceptible in residential environments. Depending on equipment used and soil characteristics, ground vibration levels from compaction can span a wide range from 0.4 mm/s PPV to a maximum of 11.0 mm/s PPV. There is often an expectation that the softer soils would produce higher amplitude vibrations, but this is not always the case. Also contrary to expectation, there is usually no significant correlation between weight of compaction equipment and resulting ground vibration level.

5.4.9 Wind and Meteorology

It was important to establish wind speed, direction and frequency when carrying out Air Quality monitoring measurements (Table 5-8) since they help to estimate the flow pattern of any generated emissions, smoke plumes direction and fire behaviour. When combined with precipitation data, wind speed can also be used to estimate the amount of vegetable cover drying. A wind rose for the Matanda Command area was plotted using a time series plotting software to generate the wind rose diagram covering the selected sites at the project area.

Table 5-8: Measured wind speeds and direction in at different locations within the proposed scheme command area

Location	Direction (^{0})	Speed (m/s)
ID_1	320 NW	3
AQ1	324 NW	1
AQ2	80 E	2.5
AQ3	89 E	1.5
AQ4	308 NW	1.2
AQ5	249 WSW	1.5
AQ6	318 NW	1.4
AQ7	204 NNW	0.6
AQ8	303 WNW	0.8
AQ9	238 WSW	2.9
AQ10	318 NW	1.4
AQ11	222 NW	1.9
AQ12	317 NW	2.4

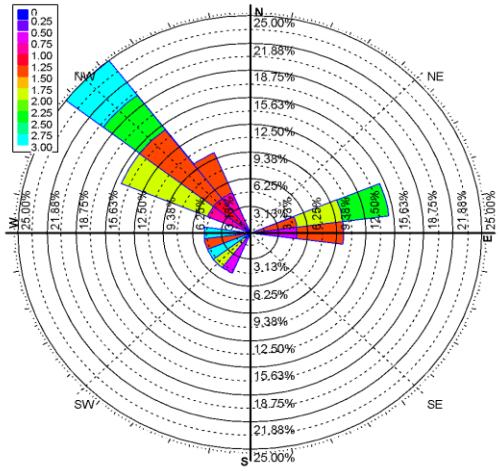


Figure 5-17: Scheme command area Wind rose plot

Inference from Measurements:

Wind Rose modeling for the Matanda Command area indicates the wind in the project area is generally moving in the Northwestern direction, characterised as a majorly level 1 (0.3 – 1.5 m/s) to Level 2 (1.6 – 3.3 m/s) on the Beaufort scale (Appendix G). This was confirmed from the time series variation of the wind direction, where each corner on the line indicated the variation in the direction of the wind at the different test points (Figure 5-21). This also indicated the direction of any potential pollutant emissions. Pollutants or emissions from this kind of wind speed are not likely to go far or exceed 6 km ranges on average.

5.4.10 Water Quality

Baseline water quality within the zone of influence is in order to understand the physicochemical properties of the environment and its effects on terrestrial and aquatic ecosystems and the search for the prevention of future bioaccumulation potentials (bioconcentration and/or biomagnification) of molecules of herbicides in living non-target organisms, minimizing their negative effects on the environment.

Table 5-9 Insitu water quality results. Numbers are average ± stdev on triplicate measurements.

	LOCATION	DO%	DO (mg/L)	pH	Temp (°C)	Atmospheric pressure (mbar)	EC (µS/cm)	TDS (ppm)	Salinity	ORP
Dry Season	R. Kiruruma (Kinyamashe)	34.83±2.74	2.56±0.06	6.62±0.15	20.67±0.06	901.83±0.12	43±16.99	21.33±8.26	0.02±0.01	-16.83±5.35
	R. Kiruruma (Nyakarumbi)	35.17±2.95	2.63±0.19	6.09±0.08	21.25±0.18	906±0	42±11.43	21±5.72	0.02±0.01	-10.53±5.73
	R. Kiruruma (Nyakashure)	21.03±0.66	1.62±0.06	6.24±0.13	22.74±0.23	910.8±0.41	50.33±11.09	24.33±4.03	0.02±0	-1.33±1.58
	R. Kiruruma-Reservoir Area	19.6±0.37	1.49±0.07	6.71±0.12	21.91±0.14	900.67±0.21	41±1.41	20.33±0.94	0.02±0	-4.63±0.87
	Spring	13.17±0.25	0.96±0.01	6.76±0.07	25.8±0.22	910.57±0.49	77.33±4.78	39±2.16	0.03±0	-15.1±1.81
Wet Season	R. Kyoganibanywa	79.53±5.6	6.28±0.43	7.25±0.02	21.36±0.09	906.97±2.3	278±3	139±1.5	0.13±0	-44.2±26.85
	Matanda Protected Spring	83.47±5.83	6.05±0.43	6.27±0.09	25.97±0.04	908.17±0.34	87.67±1.7	43.67±0.94	0.04±0	-47.47±24.77
	R. Kazinga	64.6±2.8	4.7±0.2	6.6±0.46	25.52±0.01	903.67±0.35	85±2.5	42.67±1	0.04±0	-49.6±5.3
	Kabukwenda Stream	49.4±1.35	3.86±0.1	6.75±0.11	20.89±0.03	891.27±0.45	16.67±0.5	8.67±0.5	0.01±0	-81.93±19.55
	R. Kiruruma-Reservoir Area	39.17±1.75	3.18±0.14	6.91±0.01	19.29±0.09	897.2±0.1	47.67±0.5	23.67±0.5	0.02±0	-40.6±2.1
	Kinyagwe Protected Spring	75.6±3.8	5.72±0.29	7.04±0.22	22.94±0.04	896.47±1.3	52±1.5	26.33±0.5	0.02±0	-78.17±28.55
	R. Kazinga II	51.43±1.55	3.52±0.1	7.05±0.03	28.73±0.02	903.23±0.25	74±0	37±0	0.03±0	-112.8±3.5
	Mbabazi Felix Spring	30.6±0	2.34±0	6.96±0	22.49±0	894.1±0	35±0	18±0	0.02±0	-101.2±0
	R. Kiruruma (Samaria)	24.65±1.55	1.86±0.12	6.92±0.04	24.18±0.15	908.55±0.55	53±1	26.5±0.5	0.02±0	-123.55±20.45
	Tributary to Kiruruma	44.85±11.05	2.83±0.75	7.03±0.09	32.82±0.16	909.65±0.35	142.5±0.5	71.5±0.5	0.07±0	-126.85±11.95
	Marita Shallow Well	38.5±7.8	2.89±0.6	6.9±0.04	24.65±0.03	910.47±0.12	78.33±1.89	39.33±1.25	0.04±0	-83.77±5.66
	Bore Holes (BH)									
	Kazinga BH	58.23±0.2	4.32±0	6.71±0.09	23.95±0.02	904.73±0.75	169.67±25.5	84.67±12.5	0.08±0.02	-36.1±14.7
	Muzizi Borehole	61.27±5.2	4.48±0.37	7.33±0.1	25.09±0.14	902.8±0.3	146.33±2	73±0.5	0.07±0	-171.17±38.65

Dissolved Oxygen; EC- Electrical Conductivity; TDS – Total Dissolved Oxygen; ORP – Oxidation Reduction Potential *The national potable water quality standards for pH is 5.5-9.5, EC- 2500 µS/cm, and TDS – 1500 ppm

Commentary: Generally, for all sampled locations, in situ water quality was substantially good both in the dry and wet season (Table 5-8). Sampling points around pour points of the micro-catchments had EC and TDS concentration significantly high as compared to other locations mainly attributed to

leaching from convention irrigation by rice farmers which is characterized with poor water use efficiency. A similar observation was made on ground water sources within R. Kasinga catchment where EC and TDS concentration were significantly high as compared to other locations mainly attributed to natural environmental features such as mineral springs, carbonate deposits, salt deposits which is evidenced by their elevated salinity. Comparison of different seasons (dry and wet) at the same sampling locations indicated an upsurge in the concentrations of EC, TDS and Salinity.

Table 5-10 Insitu Laboratory results – Dry Season

Sample ID/Parameter	**PA** - R. Kiruruma (Kinyamashe)	**PB** - R. Kiruruma (Nyakarumbi)	**PC** - R. Kiruruma (Nyakashure)	**PD** - R. Kiruruma-Reservoir Area	**PE** – Spring	WHO drinking water standards*
Apparent colour (PtCo)	471	590	630	570	340	ns
Turbidity (FAU)	69	80	82	85	49	5
Total suspended solids (TSS) (mg/l)	62	75	89	77	57	nil
Total Alkalinity (mg/l)	135	140	145	150	105	ns
Nitrates (mg/l)	nd	nd	nd	nd	6.3	50
Ammonia nitrogen (mg/l)	0.013	0.011	0.005	0.010	0.015	ns
Total Phosphorus (mg/l)	0.592	0.674	0.68	0.842	0.484	ns
Fluorides (mg/l)	0.20	0.20	0.30	nd	0.50	1.5
Total Iron (mg/l)	2.91	3.02	3.08	3.62	0.78	0.3†
BOD5 (mg/l)	28	31	26	42	19	ns
COD (mg/l)	78	92	52	97	50	ns

*WHO drinking water standards (20 17); ns-not specified; n.d - not detected: Detection limit for Nitrates and Fluorides is 0.0 15 mg/ l; *†For aesthetic reasons. No health-based guideline value given.*

Commentary: The water was sampled from the specified locations traversing River Kiruruma (PA-PD) and a spring (PE) to ascertain the baseline water quality. A comparison with WHO drinking water standards indicates that the water from the sampled locations does not comply for turbidity, TSS and Total Iron. Observation of the samples from these sources showed that the water is not clear due to some suspended materials. The high iron levels (>0.3mg/l) measured in all the samples are associated with undesirable taste in beverages, staining of sanitary ware and laundry. The source of the iron in the water at all the sampled locations may likely be due to the chemical composition of the soils within the catchment. The measured apparent colour and turbidity levels, suspended solids and total iron concentrations for these sources negatively impacts the aesthetics (colouration, e.g., dirty for PA) of the water. The Total Phosphorus concentrations in these water sources shows that these sources are not likely recipients of wastewaters or runoff from the catchment area containing relatively high levels of phosphorus which is associated with eutrophication. Whereas WHO does not specify standards for BODs and COD (typically wastewater quality parameters), a comparison with national effluent discharge standards shows that these are below (BODs<50mg/l; COD<100mg/l). However, locations PB and PD may be recipients of relatively high strength wastewater (with high organic material).

Table 5-11: Laboratory Results – Wet Season

Sample ID/ Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13
Apparent colour (PtCo)	0	1044	1748	0	0	2550	101	670	826	441	332	358	107
Turbidity (FAU)	1	186	233	7	4	369	13	102	47	65	54	227	217
Total suspended solids (TSS) (mg/l)	4	235	205	3	2	432	6	94	23	95	43	261	14
Total Alkalinity (mg/l)	105	85	10	50	90	70	30	45	30	90	30	95	40
Nitrates (mg/l)	11.6	nd	nd	24.8	15.1	nd	19.7	nd	nd	83	nd	nd	12.3
Ammonia nitrogen (mg/l)	0.011	0.070	0.026	nd	0.021	0.069	0.019	0.042	0.104	0.041	0.121	0.363	0.050
Total Phosphorus (mg/l)	0.119	1.049	0.800	0.651	0.430	0.720	0.478	2.067	1.155	1.253	0.640	1.144	0.850
Fluorides (mg/l)	2.05	1.95	1.65	0.50	0.55	0.45	0.30	1.50	0.05	1.45	0.15	1.45	0.55
Total Iron (mg/l)	0.04	1.25	1.32	0.08	0.06	3.48	0.42	2.94	1.37	0.37	0.44	3.98	0.31
Sulphates (mg/l)	29.9	108.2	37.0	23.3	6.8	5.2	12.5	25.2	4.1	30.7	8.4	27.2	16.5
BODs (mg/l)	2	13	9	5	nd	nd	8	1	2	16	5	nd	1
COD (mg/l)	18	40	23	20	21	12	24	8	10	37	13	17	9

Key: Kazinga BH (1), R. Kyoganibanywa (Matanda) (2), Matanda Protected Spring (3), R. Kazinga (4), Kabukwenda Stream (5), R. Kiruruma-Reservoir Area (6), Kinyagwe Protected, Spring (7), Muzizi Borehole (8), R. Kazinga II (9), Mbabazi Felix Spring (10), R. Kiruruma (Samaria) (11), Tributary to Kiruruma (12), Marita Shallow Well (13); ; n.d - not detected: Detection limit for Nitrates, Ammonia nitrogen and BODs is 0.015, 0.008 and 10 mg/l respectively. WHO threshold concentrations in drinking-water are 250–500 mg/l (median 350 mg/l) for sodium sulfate, 250–1000 mg/l (median 525 mg/l) for calcium sulfate and 400–600 mg/l (median 525 mg/l) for magnesium sulfate

Commentary: The water was sampled during a wet season from the specified locations traversing 3 rivers (i.e Kiruruma, Kazinga, Kabukwenda, and Matanda) and ground water sources to ascertain the baseline water quality. A comparison with WHO drinking water standards indicates that the water from the sampled locations does not comply for turbidity, TSS, Fluorides and Total Iron. The measured apparent colour and turbidity levels, suspended solids and total iron concentrations for these sources negatively impacts the aesthetics (colouration, e.g., dirty for 1, 2, and 6) of the water. The dependence of agriculture on chemical pesticides and herbicides (Butanchlor, Propanil and Atropine Sulphate) which are a vital input in today's agriculture, protecting food and fiber from damage by insects, weeds, diseases, nematodes, and rodents was evident in the project area (Figure 5-22). However, results show naturally occurring concentrations of the chemical constituents like sulphates not harmful to humans if used as directed thus the monitoring plan shall ensure awareness that some agricultural chemicals blight the environment. Sampling over different seasons indicates a rise in concentrations of TSS, Apparent color, and Turbidity. The Total Phosphorus concentrations in these water sources shows that these sources are not likely recipients of wastewaters or runoff from the catchment area containing relatively high levels of phosphorus which is associated with eutrophication. Whereas WHO does not specify standards for BODs and COD (typically wastewater quality parameters), a comparison with national effluent discharge standards shows that these are below (BODs<50mg/l; COD<100mg/l).

5.5 Biological Environment

5.5.1 Flora

Kanungu district has a total area of 1,228.28 sq km, comprising 60 percent small-scale farmland, 15 percent high tropical forest, 11 percent woodland, 9 percent grassland, 2 percent bush land, one percent open water and 2 percent miscellaneous mosaics. The vegetation ranges from the high tropical forests of Bwindi impenetrable National Park to the grasslands of Queen Elizabeth World Heritage and a wide array of cropland.

Vegetation assemblages

The vegetation cover sampled comprised of eight vegetation types, i.e., Riverine tree strips, riverine woodland, bushland, wooded-bushland, grassland with scattered trees, cultivations-fallows, marsh and swamp, crop gardens, tree woodlots, patches of riverine bushed woodland: strips of mixed woody vegetation along the river, patches of bushed woodland (colonizing forest) on uncultivated private land and grassland fallow amidst of cultivated sites Appendix E. All these vegetation types within the project area are influenced by agriculture and settlement.

Species Richness

The site yielded 233 plant species (Appendix E) in 170 genera and 57 families. Family fabaceae (leguminous plants) and family Poaceae (grasses) registered the highest number of species i.e., 36 and 32 species respectively. These were accompanied by Asteraceae with 16 species, Moraceae followed by 12 species, and Euphorbiaceae with 11 species. Majority of the family registered less than four (4) species.

The tree species included, (i) Those close to the river (within less than 50 m from the river): Eucalyptus sp., Flame tree (*Erythrina abyssinica*), Indian tree spurge (*Euphorbia tirucalli*), False cape fig (*Ficus vallis-chaoudae*), American Acacia (*Senna spectabilis*), Wild date palm (*Phoenix reclinate*), Parasol leaf tree (*Macaranga schweinfurthii*), Silk ork (*Grevilea robusta*), Coastal golden leaf (*Bridelia micrantha*), Ochol (*Pseudospondius micropcarpa*), Egyptian riverhemp (*Sesbania sesban*), and Pinwheel flower (*Tabanaemontana holstii*). (ii) Those away from the river (between 50 and 500 m from the river): Oil palm (*Eleis guianensis*), Sausage tree (*Kigelia africana*), Guava tree (*Psidium guajava*), Cape fig (*Ficus sur*), Backcloth fig (*F. natalensis*), African tulip (*Spathodea campanulate*), Nile tulip (*Markhamia lutea*), Forest velvet (*Allophyllus abyssinica*), Jumping-seed tree (*Shirakiopsis elliptica*), Light wood (*Luganda – Mugavu*) (*Albizia coriaria*), Forest fever tree (*Anthocleista grandiflora*) and Broad leaved croton (*Croton macrostachyus*). Within the upper Kiruruma river section from Ibumbwe towards the generator section, apart from Eucalyptus sp., a plantation species, the most abundant tree in areas approximately 300m away from the river was the broad-leaved croton, Croton machrostachyus, while along the river it was Macaranga schweinfurthii. The areas between R. Ntungwe and Kasinga stream covering the villages between Kameme and Kanyinabulimano is mainly under crop farming dominated by maize Zea mays, cassava Manihot esculenta, Banana Musa sapientum and rice Oryza sativa, mainly in the wet areas. The area also has several monocultures stands of Eucalyptus Eucalyptus grandis and pine Pinus patula.

Table 5-12: Species richness at Family level from the sampled sites

Family	No. of Species	Family	No. of Species	Family	No. of Species
Acanthaceae	3	Cyperaceae	9	Pedaliaceae	1
Amaranthaceae	5	Dioscoreaceae	1	Phyllanthaceae	6
Anacardiaceae	3	Dracaenaceae	2	Pinnceae	1
Apiaceae	2	Euphorbiaceae	11	Plantaginaceae	1
Apocynaceae	4	Fabaceae	36	Poaceae	32
Araceae	1	Lamiaceae	5	Polygonaceae	2
Araliaceae	1	Lauraceae	1	Proteaceae	1
Arecaceae	1	Malvaceae	6	Rhamnaceae	1
Asteraceae	16	Marantaceae	1	Rubiaceae	4
Bignoniaceae	2	Melastomataceae	1	Rutaceae	1
Boraginaceae	1	Meliaceae	1	Sapindaceae	3
Brasicaceae	1	Menispermaceae	2	Sapotaceae	2
Bromeliaceae	1	Moraceae	12	Scrophulariaceae	1
Cairicaceae	1	Musaceae	3	Solanaceae	7
Capparaceae	1	Myristicaceae	1	Sterculiaceae	4
Combretaceae	1	Myrsinaceae	1	Ulmaceae	1
Commelinaceae	4	Myrtaceae	3	Urticaceae	1
Convolvulaceae	6	Oleaceae	2	Verbenaceae	3
Cucurbitaceae	4	Onagraceae	2	Vitaceae	2

Plant species abundance

90 percent of the scheme vegetation cover consists of crops of which maize, coffee, banana, cassava and millet cover about 80%. The natural vegetation cover constitutes less than 10% of the total vegetation cover. Majority of natural trees are found in coffee and other crop gardens. Albizia, Markhamia and Ficus species are common within coffee plantations and on other crop gardens. Rice (*Oryza sativa* gardens) are common along the river valley whereas millet, maize, sweet potato and sugarcane are common even on dry land. Natural vegetation is limited within the landscape, and it is common on steep slopes and some sections of the river that experienced river capture. The average percentage cover of plant species recorded within the landscape are provided in Appendix E.

Growth Form Distribution of Plants of Matanda Scheme

From the survey only 67 tree species were recorded of which Coffee trees, and Eucalyptus trees were the most abundant. The site yielded 23 shruby species and among these Cassava (*Manihot esculenta),* Red

sage *(Lantana camara),* Bitter leaf *(Vernonia amygdalina),* Corn plant *(Dracaena fragrans),* Indian copperleaf *(Acalypha bipartite),* Copper leaf *(Acalypha ornate),* Christmas bush (*Alchornea cordifolia)* were the most abundant. The site yielded 12 climbers, 74 forbs and 32 grasses, 8 sedges and 1 rush (Figure 5-23).

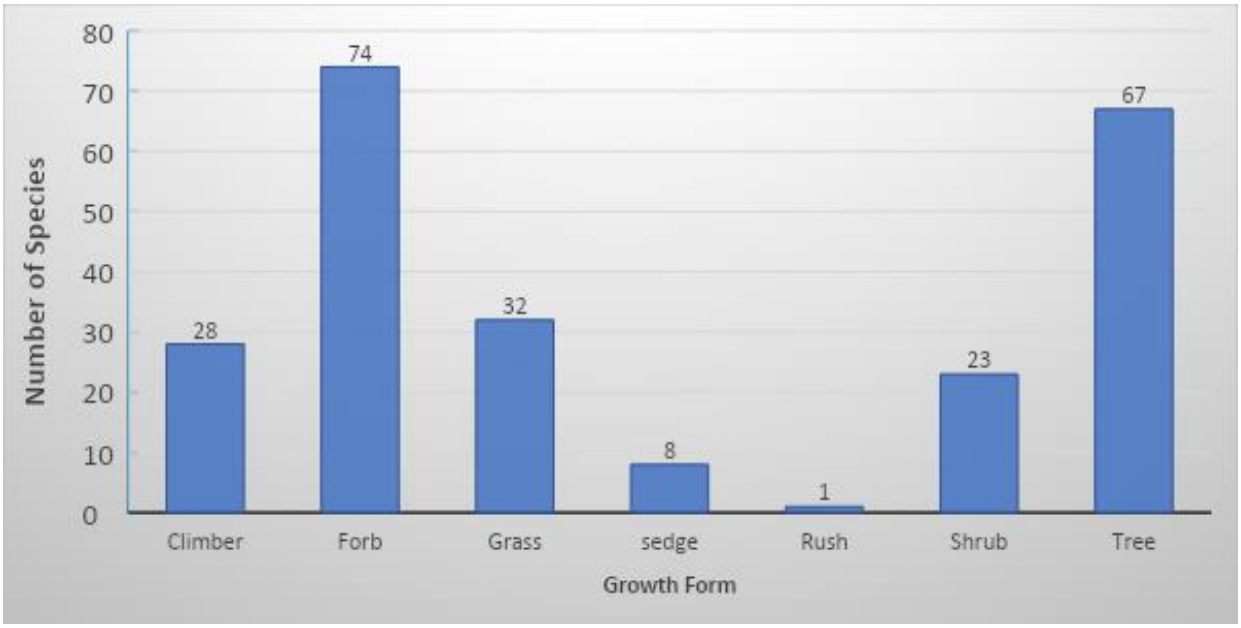


Figure 5-18: Growth Form Distribution of Plants recorded from Matanda Scheme

Species of Conservation Concern

Three flowering plants of the species African linden (*Mitragyna stipulosa)* were found in Sugarcane Garden along River Kiruruma at geo-location 35 M 802757, 9913788 and 0802869, 9915424, a species is listed as Vulnerable (VU) as per IUCN 2019 Red List data. An African teak, mvule or iroko (*Milicia excelsa*) listed as Near Threatened (NT) at global scale and Endangered (EN) at National level (IUCN 2018 and WCS 2016) was found at geo-coordinates 35 M 0797043, 9914360. A brown or Kilimanjaro mahogany (*Lovoa swynnertonii*) Bak.f, which is VU at global and national scale, was encountered at Nyamabare, Karubeizi on 35 M 0802921, 9915387. Water withdrawal will not impact these plant species since they are widely distributed in the project area and across Uganda. The rest of the plants recorded from the project site are Least Concern (LC) species and some are not evaluated (NE).

Species listed under schedule 8 of the National forestry and tree planting act 2016

Among these species were *Milicia excelsa*, *Lovoa swynnertonii, Mitragyna stipulosa, Albizia coriaria, Albizia glaberrima, Albizia grandibracteata, Albizia zygia, Pterygota mildbraedii* and *Pinus caribaea* (all cornifers), recorded along River Kiruruma and within the project area. The *Albizia spp* are distributed scattery within the Matanda irrigation scheme.

Note

The species recorded were largely of Least Concern according to IUCN. This is due to their wide geographical distribution, stable national and global populations as well as high adaptability to human modified areas. The

project area vegetation cover is dominated by fields of cultivation for both subsistence and plantation farming. Gardens with variety of crops such as banana (*Musa spp*), sweet potatoes (*Ipomoea battatus*), cassava (*Manihot esculenta*) and maize (*Zea mays*) occupied the largest expanses on hill tops and valleys up to almost the river line and scattered trees included *Albizia coriaria, Albizia grandbracteata, Croton macrostachyus, Pseudospondius macrocarpa, Macaranga s*pp, *Piptadeniastrum africanum*, *Antiaris toxicaria* and Ficus sp. Riverine areas in Ntungwe close to the Park boundary were also dominated by *Acacia xanthopholea*.

These were interspaced with woodlots/ small plantations of Eucalyptus sp, Coffea sp and some Sugar cane plots. Natural vegetation only survived on the river and some sections with steep slopes such that cultivating there is almost impossible while within the cultivation matrix mimics of natural vegetation were informing of fallows. Appendix E gives the descriptions of the dominant landscape cover types along the river.

The area is largely vegetated during the growing seasons of crops and cleared during the garden's preparation season. The entire project area could therefore be classified as moderately to largely modified during the growing season and seriously modified during the garden's preparation period, especially close to the river based on the extent of gardens and woodlots/ small plantations and such modified habitats do not conform to IFC (2012) descriptions of modified habitats with conservation value and are not provided for by World Bank E&S (2001) criteria. Such habitats owned privately are subject to alteration by the will of the owner so there is no way the developer can be compelled to conserve them.

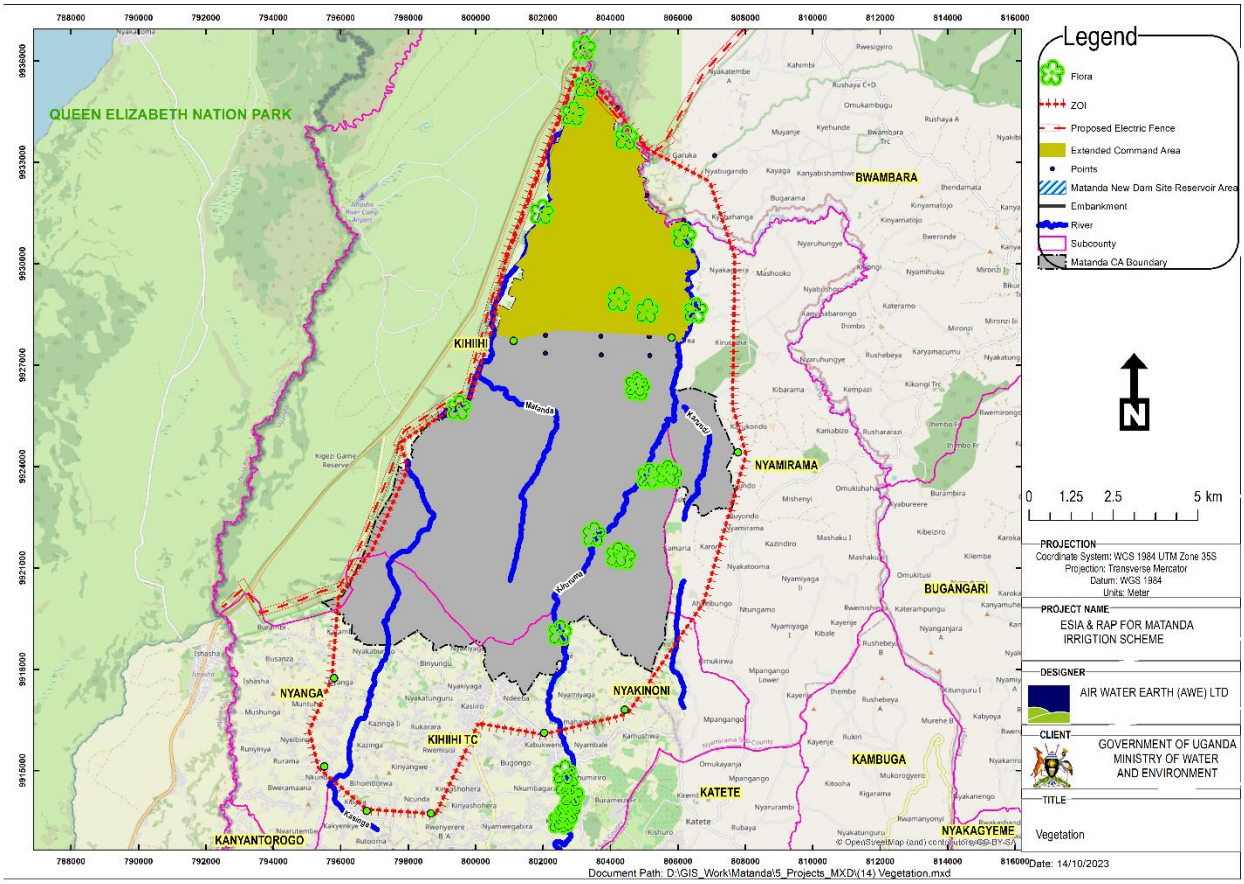


Figure 5-19: Vegetation within the extended command area

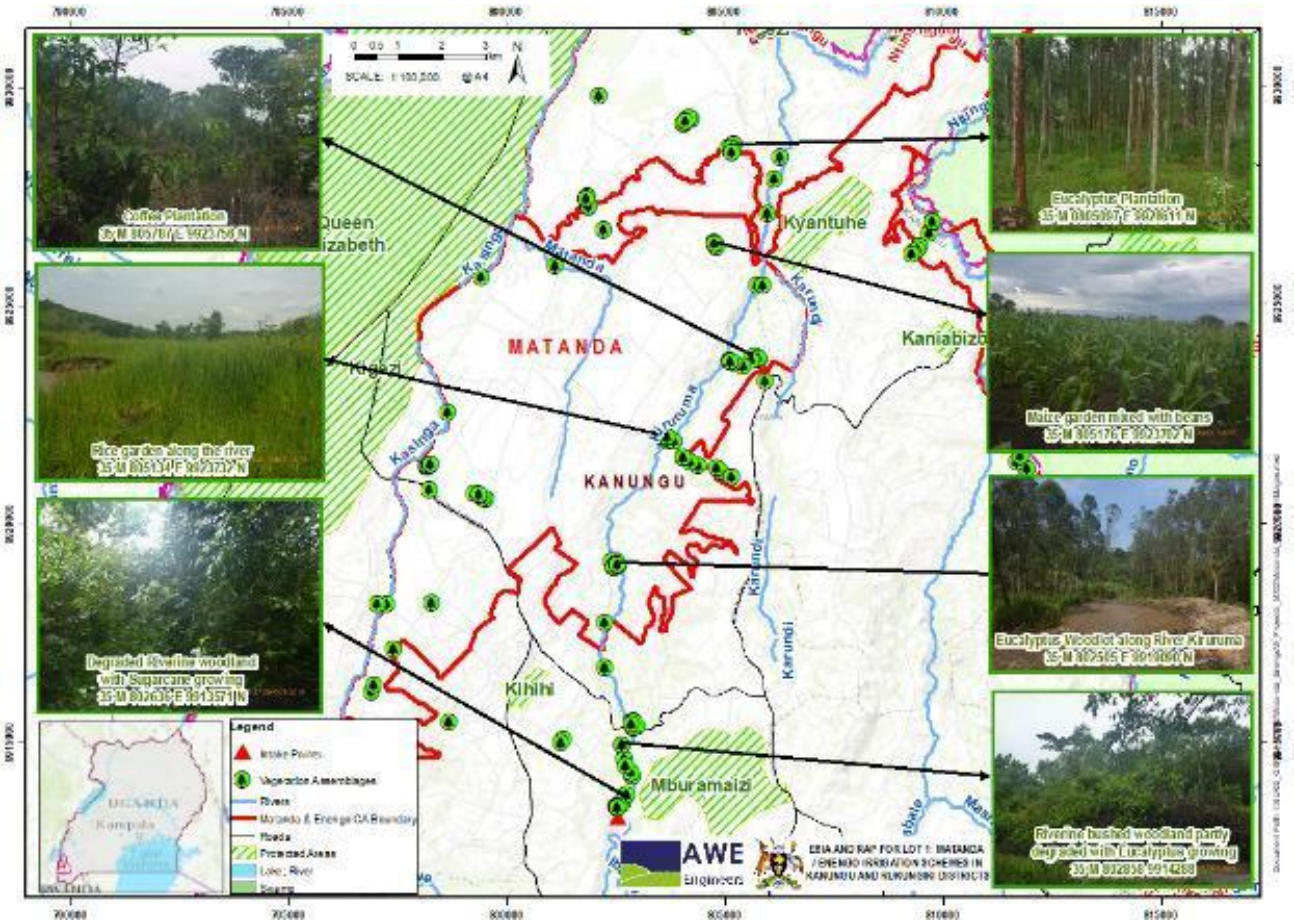


Figure 5-20: Environmental/ Vegetation status along R. Kiruruma in the proposed Matanda Irrigation Scheme command area

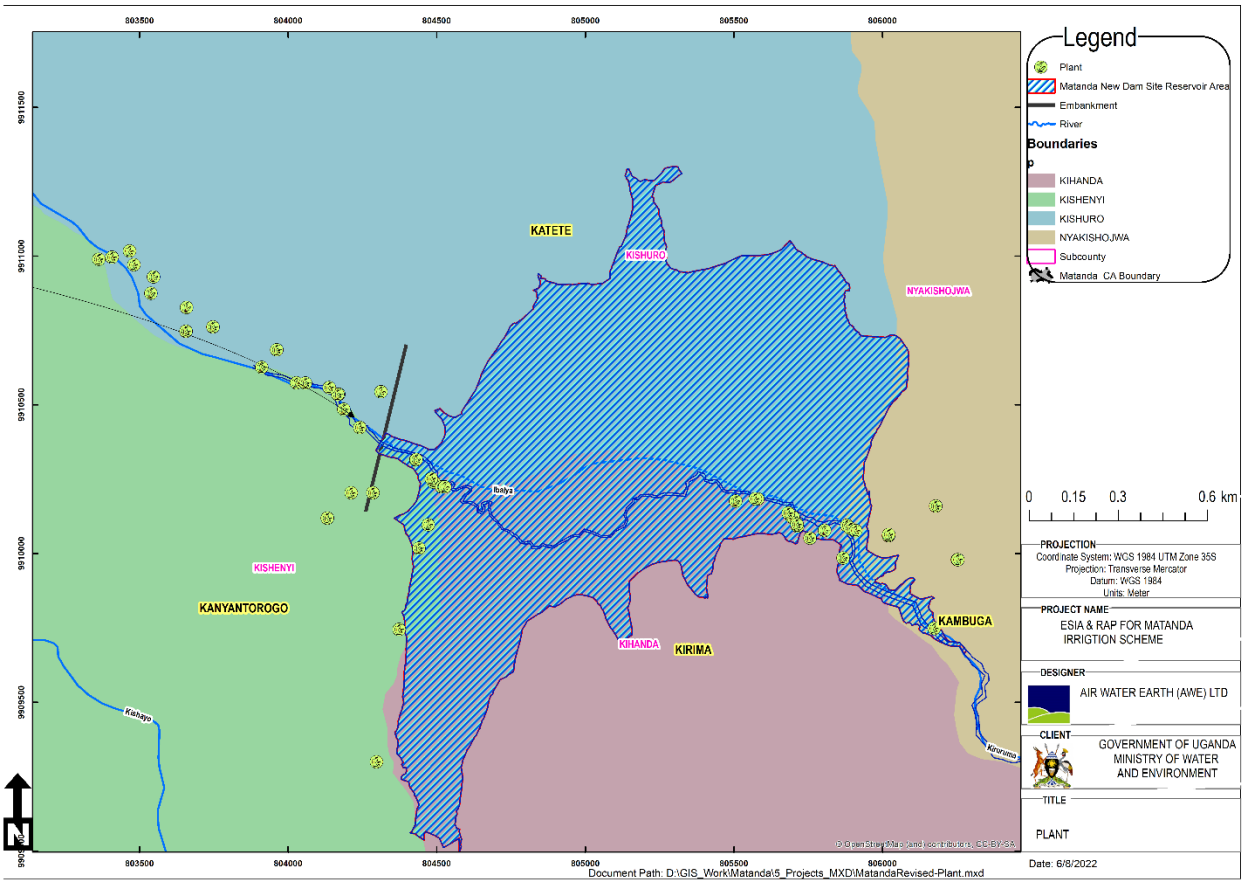


Figure 5-21: Environmental/ Vegetation status along R. Kiruruma in the proposed Matanda Irrigation Scheme dam site

Table 5-13 Description of habitat types in the project area for Matanda Dam

Landscape cover	Description	Biodiversity value within
Gardens	Consisted of areas cultivated with a single crop or a variety of crops that were weeded or un-weeded	Interspaced mature trees, riverine sections and cliffs
Woodlots/ small plantations	Mainly Eucalyptus sp. exotic tree species mainly planted for poles, timber and fuelwood	Not sensitive under any jurisdiction
River	Valley section with flowing water	Sections covered with riverine natural vegetation either at the banks or within flowing water, steep slopes and sections with highly reduced water velocity

Subsistence cultivation of maize up to river line at 35 M 802622 9913549

Eucalyptus sp. and Sugarcane (Saccharum officinarun plantations along river Kiruruma at 35 M 802680 9913669

Photo 5-1 Appearances of the largest sections of River Kiruruma

Lone 'siting'

A few species were sited only once during the entire survey, these included trees: *Kigelia africana* (35 M 0804322 9910362), *Ficus sur* (35 0804460 9910281) and *Elaeis guineensis* (35 M 0804430 9910315), the shrub *Solanum bateceum* (35 M 0805695 9910122) (Figure 5-27), and the orchid *Eulophia alta* (35 M 0803407 9910996).

Photo 5-2: A lone individual of *Solanum bateceum* (left) and *Ficus sur* (right)

It is worth noting that the primary ecosystem functions and species composition of the area has been altered by human activities. However, some sections along the river such as vegetation within flowing water, steep slopes (Lucie *et al*. 2016) and sections with highly reduced water velocity still have sound ecological integrity and are still categorized among the naturally existing habitats. The conservation value and ecological importance of these areas are therefore worth protecting by ensuring that water levels do not go far below normal fluctuation levels. Additionally, since all animals depend directly or indirectly on plants, plants could be used as a benchmark for monitoring changes or modifications in ecosystems.

Invasive Plant species

From the surveyed area *Rewd sage (Lantana camara),* and Golden wonder tree (*Senna spectabilis),* are listed on global invasive species website as notorious alien invasive species in East Africa that require careful and prompt management. These were recorded mainly along the river, and they are very limited within the scheme area. They are known to suppress herbaceous plants and compete favorably with natural indigenous plants whenever there is a gradual or sharp change in climatic conditions, and as well as disturbances in the plant community. Other invasive species encountered within the project area listed mainly by agricultural departments include *Bidens pilosa, Ageratum conyzoides*, and *Imperata cylindrica*. These mainly out compete crops and they are common weeds within the landscape. Table 5-14 provides geolocation of all invasive plant species recorded from the project area.

Table 5-14: Geolocation of invasive plant species identified from the Matanda scheme

35 M 0799388 / 9920641	*Lantana camara* *Cymbopogon nardus (L.) Remdle* *Imperata cylindrica (L.) Beauv. var. Africana*
35 M 0799534 / 9920565	*Imperata cylindrica (L.) Beauv. var. Africana* *Lantana cámara*
35 M 0805097 / 9928611	*Imperata cylindrica (L) Beauv. var. Africana* *Lantana camara L.*
35 M 0805230 / 9928689	*Senna siamea Lam.* *Lantana camara L.*
35 M 0804107 / 9929208	*Imperata cylindrica (L.) Beauv. var. Africana* *Lantana camara L.* *Senna siamea Lam.*
35 M 0804153 / 9929238	*Senna siamea Lam.* *Imperata cylindrica (L.) Beauv. var. Africana*
35 M 0804258 / 9929249	*Imperata cylindrica (L.) Beauv. var. Aficana*
35 M 0802869 / 9915424	*Mimosa pudica L.*
35 M 0802921 / 9915387	*Lantana camara L.* *Senna spectabislis*
35 M 0802543 / 9919090	*Lantana camara L.* *Senna spectabilis (DC.) H. S. Irwin*
35 M 803510/ 9921992	*Senna spectabilis (DC.) H. S. Irwin* *Lantana camara L.*

	Acacia hockii De Wild.
35 M 803621/ 9921959	*Lantana camara L.*
35 M 805536/ 9923681	*Lantana camara L.* *Senna spectabilis*
35 M 802689 9913713	*Lantana cámara*
35 M 804227 9931830	*Lantana camara*
35 M 806536 9923701	*Mimosa pigra*

Water requirements

Plant life sustains several taxa lifelines along the river by providing catchment, filters, ambient water temperatures through provision of shade, food in form of debris as well as the lower plant life for survival of aquatic fauna. Transpiration and evapotranspiration are processes that keep the water cycle between plants and the river system. Most of the riverine pristine vegetation has been converted due to crop husbandry leaving most parts of the river exposed. Therefore, what remains in terms of riverine cover is important for survival of the entire habitat that lay along the river and beyond.

5.5.2 Mammals

Overall, 28 species of mammals were recorded from 12 families in the project impact and influence area (Table 5-14). Of these, four species were large mammals, eight species were medium-sized mammals while the rest (16) species were small mammals. Mammalian species recorded were mostly in and along the river with a few especially rodents recorded in the gardens adjacent to the river. The mammalian population of the study area is deplorable especially with regard to large and medium sized mammals except in areas that border Queen Elizabeth Park. This is because of the nature of the project area that has been greatly modified through cultivation.

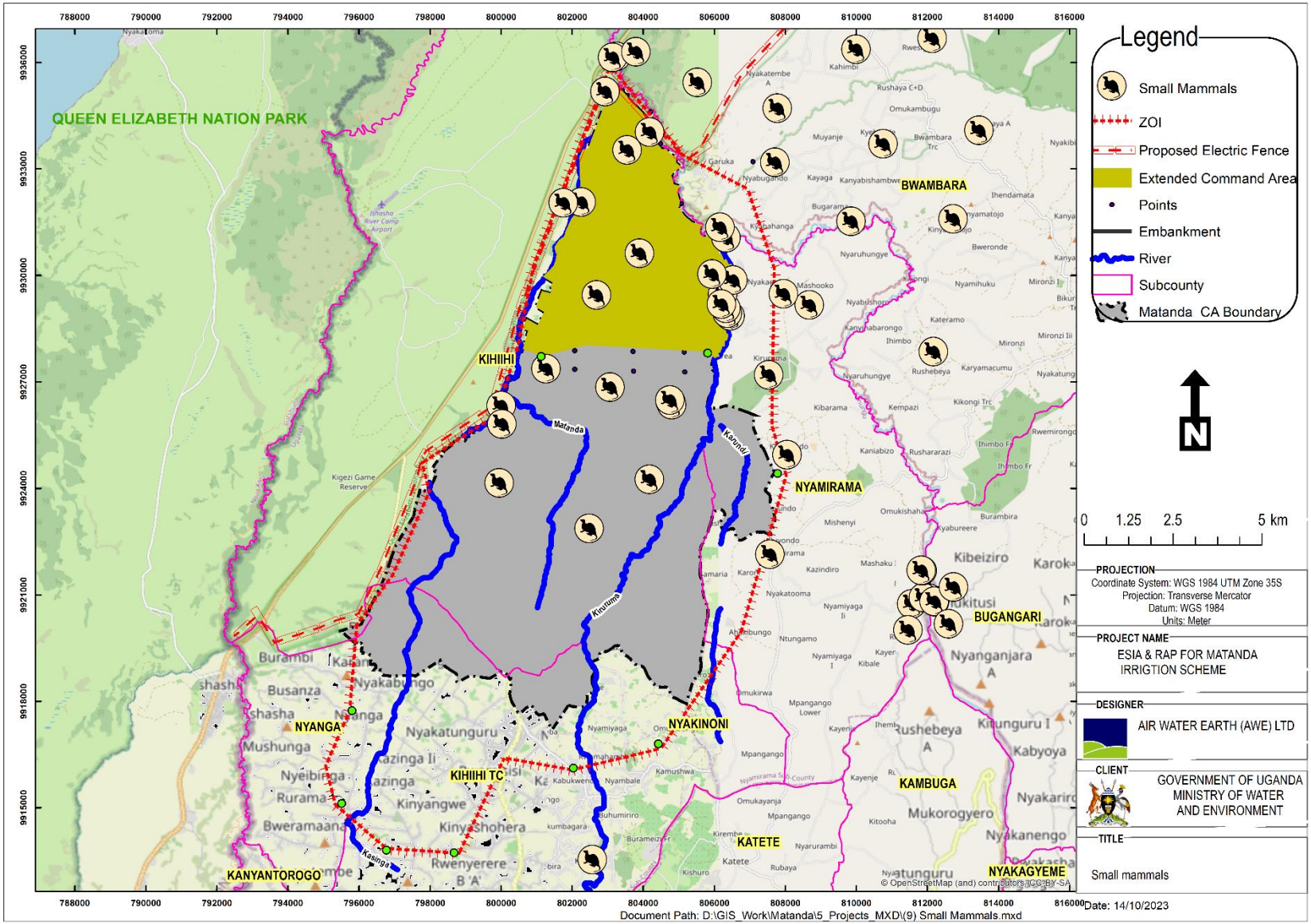


Figure 5-22: Mammals' biodiversity assessment sites in the proposed Matanda Irrigation Scheme command area

Among the large mammals, the elephant recorded the highest number (11) followed by hippopotamus (7), both usually causing conflict with neighboring communities. For the medium-sized mammals, the Black and white colobus (*Colobus guereza*) recorded the highest number (7) followed by the vervet monkey (*Chlorocebus pygerythrus*), a vermin species according to the Uganda legal framework and the Marsh mongoose (*Atilax paludinosus*) with two individuals while the rest of the species, each recorded a single individual. Among the small mammals recorded, the Common House Rat (*Rattus rattus*) recorded the highest number of individuals (six) followed by the Multimammate rat (*Mastomys natalensis*) with five individuals.

These findings indicate low species richness given the size of area and its proximity to species rich protected areas, mostly Queen Elizabeth National Park. This can be attributed to intensive agriculture and effective management of the fields which led to loss of natural habitats that would otherwise support a variety of mammalian fauna. However, diversity increases with proximity to the park. Details of the findings are annexed in the biodiversity report (Appendix E).

Table 5-15:Species richness at Family level from the sampled sites

Family	Species	Common name	Global conservation status (IUCN)	No. recorded
Large-sized mammals				
Elephantidae	*Loxodonta africana*	African bush elephant	Endangered	11
Hippopotamidae	*Hippopotamus amphibius*	Hippopotamus	Vulnerable	7
Bovidae	*Cyncerus cafer*	African buffalo	LC	2
Medium-sized mammals				
Bovidae	*Tragelaphus scriptus*	Bushbuck	LC	1
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet monkey	LC	3
Cercopithecidae	*Colobus guereza*	Black & white colobus	LC	7
Felidae	*Felis lybica*	African wildcat	LC	1
Felidae	*Pantera Leo*	African lion	VU	2
Viverridae	*Civettictis civetta*	African civet	LC	1
Herpestidae	*Atilax paludinosus*	Marsh mongoose	LC	2
Herpestidae	*Galerella singuinea*	Slender mongoose	LC	1
Herpestidae	*Ichneumia albicauda*	White tailed mongoose	LC	1
Mustelidae	*Hydrictis maculicollis*	Spotted-necked otter	Near Threatened	1
Small mammals				
Nesomyidae	*Cricetomys emini*	Giant Rat	LC	1
Soricidae	*Crocidura olivieri*	African giant shrew	LC	2
Soricidae	*Crocidura nigrofusca*	African black shrew	LC	1
Soricidae	*Crocidura turba*	Turbo shrew	LC	1
Muridae	*Rattus rattus*	Common House Rat	LC	6

Family	Species	Common name	Global conservation status (IUCN)	No. recorded
Muridae	*Mus minutoides*	African Pygmy Mouse	LC	3
Muridae	*Arvicanthis niloticus*	African bush rat	LC	2
Muridae	*Lemniscomys striatus*	Striped grass rat	LC	3
Muridae	*Lophuromys aquilus*	Gryay spotted brush furred rat	LC	1
Muridae	*Lophuromys laticeps*	Bush furred rat	LC	1
Muridae	*Aethomys hindei*	Hinde's rock rat	LC	1
Muridae	*Mastomys natalensis*	Multimammate rat	LC	5
Muridae	*Praomys jacksoni*	Jackson's soft-furred mouse	LC	1
Muridae	*Grammomys sp*	Thicket rat	LC	1
Muridae	*Gerbilliscus sp*	Gerbil	LC	1
Small mammals – flying mammals				
Pteropodidae	*Epomophorus labiatus*	Ethiopian epauletted fruit bat	LC	Many

LC = Least Concern catergory of the IUCN

Species diversity

The Kishunju cell had the highest diversity index at 2.32. This could be attributed to the relatively dense habitats, which offered more cover for different species thus increasing the species richness and evenness. Group farm B had the least diversity index at 1.52. Typical Shannon-Wiener (*H'*) values are generally between 1.5 and 3.5 and the index is rarely greater than 4 (Kerkhoff, 2010) and the Shannon-Wiener increases as both the richness and the evenness of the community increase (Appendix E). The riverine habitats on River Kiruruma formed a relatively substantial vegetation cover. These offered a variety of refugia and food for the mammals.

Large-sized mammals

This had four species from four families; Elephantidae, Hippopotamidae, Bovidae and Felidae. All the four species are common in Queen Elizabeth Park but usually escape into the neighboring Kameme community causing human-wildlife conflict through crop damage and livestock predation. The elephants usually move in families led by a female; matriarch, and usually cause extensive crop damage given their numbers. Within Queen Elizabeth, there has been a quickly recovering population of elephants although still under threat due to poaching mainly for ivory. The African bush elephant is globally and nationally Endangered. The hippopotamus has also been growing up in numbers in Queen Elizabeth Park but is also under poaching and habitat encroachment threats and is listed as globally Vulnerable. The African Buffalo also strays into the Kameme community but usually reported in small numbers or lone individuals. The species is both globally and nationally Least Concern (LC). The lion is globally Vulnerable and it has had a drastic fall in numbers due to mainly retaliatory poisoning after predation of domestic animals as well as poaching for ritual purposes. Livestock predation has been reported in the neighboring Kameme community.

Medium-sized mammals

This had ten species from six families: Felidae, Mustelidae, Herpestidae, Bovidae, Viverridae and Cercopithecidae. The Vervet monkeys of family Cercopithecidae are a common sighting in the project area of impact mainly within the riverine vegetation but also causing crop damage as vermins. The only Bovidae recorded in this study was the bushbuck which is a widespread species of antelope in Sub-Saharan Africa. The marsh mongoose is mainly restricted to riparian habitats (rivers, streams, swamps, marshes and dams), wherever there is suitable vegetation cover and water in close proximity while the Spotted-necked otter prefers deep fresh water and is mainly in the Lake Victoria basin. The African civets live both in the forest and in open country as a common species. The White-tailed mongoose and Slender mongoose have a large distribution and are common in human-modified habitats mainly feeding on insects, termites, beetles, grasshoppers' crickets and sometimes amphibians. The African wildcat is widely distributed in Africa. However, these species are all one-off records, and their densities cannot be estimated within the surveyed areas.

Rodents and shrews

All the 16 species recorded under small mammals fall under four families: Nesomyidae, Soricidae, Muridae and Pteropodidae. For family Nesomyidae, only one species, the Giant rat (*Cricetomys emini*) was identified while for family Soricidae, three members of order Eulipotyphla, *C. olivieri, Crocidura nigrofusca* and *Crocidura turba* were recorded all of which are widely distributed in many biotic zones.

For the Family Muridae, Order Rodentia, the Common House Rat *Rattus rattus* was the most abundant (six individuals) followed by Multimammate rat (*Mastomys natalensis*) (five individuals) and both African Pygmy Mouse (*Mus minutoides*) and Striped Grass rat (*Lemniscomys striatus*) each recorded three individuals. The African Giant Shrew *Crocidura olivieri* and the African bush rat (*Arvicanthis niloticus*) each recorded two individuals while the rest; African giant rat *Cricetomys emini,* African black shrew *Crocidura nigrofusca,* Grey-spotted brush furred rat *Lophuromys aquilus,* Bush-furred rat *Lophuromys laticeps*, Hinde's Rock rat *Aethomys hindei,* Jackson's soft-furred mouse *Lophuromys aquilus*, Thicket rat *Grammomys sp* and Gerbil *Gerbilliscus sp* each recorded a single individual.

The findings are in tandem with observations made elsewhere by Muller (2018), who noted that rodents are the largest group of mammals in the world and can adapt to life in any habitat. The rodents recorded here are some of the commonest in Uganda and Eastern Africa and are extremely adaptable. They occur in natural grasslands and thickets, wooded savannah, cultivated areas and in villages (Jackson, 2015).

Flying mammals

For small-flying mammals*, E. labiatus* of the Family Pteropodidae and order Pteroporididae was the only bat species recorded with several members flying in the air. A number of fig trees, potential roosting sites, were observed in the study sites.

Species of conservation concern

Three species of conservation concern were recorded with three of these not known community resident species but rather escaping from Queen Elizabeth National Park into neighboring communities. These included; the African bush elephant which is globally and nationally Endangered, Hippopotamus which is globally and nationally Vulnerable and the African lion which is globally Vulnerable. One resident species within the community cultivation recorded during this survey (Spotted necked otter) is threatened as listed by both IUCN (global) and the National Lists (WCS 2016). Although known to be widespread in Uganda, the species is globally Near Threatened (NT) and nationally Endangered (EN C1). It has a preference for deeper flowing waters where it hunts for fish but also preys on frogs, crabs and small water birds. It is known to occur in several clearer and deeper flowing rivers around and beyond the project area, but it is rarely sighted.

Estimated water consumption by mammals

Over 90% of the proposed project area is under different forms of cultivation with little pristine environment to guarantee tenable numbers of mammals. This therefore leaves the agile and highly adoptive small mammals to survive in sizable numbers. The use of and volumes of water consumed by mammals depends on a number of factors. Diets low in moisture or high in fiber, salt, sodium bicarbonate, or protein increase water consumption (Harris and Van Horn, 1992). Increased air temperatures and aridity increase water loss and the amount of water consumed for replacement. Some conditions can induce abnormal water intake. However, on average, from experimental animals in captivity, daily water intake of primates is approximately 60.2 ± 22.5 ml/kg while mice drink 3-5 ml a day (1.5 ml/10 g body weight/day).

From the results, large mammals are mainly sustained by the park while the number of medium sized mammals that remain within the proposed sites is very small given the unprecedented loss of habitat. This also reduces the nature and level of impact on water for wildlife due to the irrigation scheme downstream. Only small mammals, especially highly adaptive species exist in sizable numbers with species diversity ranging between 1.6 to 2.32. Although their numbers may warrant volumes of water, the daily individual consumption is too small for the dam processes to cause significant water stress to the small mammal population. However, hydrological values calculated shall be those that maintain continuous water flow downstream throughout the dry season.

5.5.3 Birds

The site was divided into the lower and the upper sections of Matanda based on the river flow and the Ntungwe-Kiruruma section which is next to Queen Elizabeth National Park. The lower section was further divided into the riverine section comprising of Kiruruma, Rwangoboka, Nyakarambi, Nyakashure and Nyabubare villages while the impact area comprised of villages; Group farm, Nyakashure, Nyakarambi, Matanda I, Matanda II, Kashojwa and Bihomborwa.

The upper section of the river comprised of Kichura I, Kichura II, Kanyugusi, Generator and swamp along the riverine section while the impact area comprised of Kichura 1, Ibumbwe, Kanyugusi, Ibaja cell I, Ibaja cell II, Generator I and generator II.

The Ntungwe-Kiruruma section comprised of Bukorwe, Kazinga, Kameme, Karambi, Kanyabutungo, Rwerere and Kanyinabulimano villages. The flow of results is therefore arranged along these sections.

Lower section of Matanda

Species diversity and relative abundance

The area recorded 104 species of birds. The river sites surveyed recorded an average of 31 species each while the impact areas survey recorded only 26 species on average per site (Appendix E). The most abundant species and their relative abundance in the river sites included Blue-spotted Wood Dove (*Turtur afer*) (4.4), Speckled Mousebird (*Colius striatus*) (4.2) Red-faced Cisticola *Cisticola erythrops* (4.2) and Tropical Boubou *Laniarius aethiopicus* that are mosly forest visitors. The impact area however, recorded Common Bulbul *Pycnonotus barbatus* (5.14), Red-faced Cisticola *Cisticola erythrops* (5.43), Tawny-flanked Prinia *Prinia subflava* (5.83) and Red-eyed Dove *Streptopelia semitorquata* (5.0).

Habitat specialization

Habitat classification provides an indication of bird diversity that a particular area can hold. There are species that are very sensitive to habitat types and therefore need protection. There were no Forest specialists (FF), recorded. However, there were 11 and 17 Forest generalists (F) from the impact areas and the river sites respectively (Figure 5-30). These are birds typical of forest edges and gaps. They include Long-crested Eagle *Lophaetus occipitalis*, Blue-spotted Wood Dove *Turtur afer* and Black-and-White Casqued Hornbill *Bycanistes subcylindricus* among others; there were 24 and 22 forest visitors recorded from the impact area and riverside sites respectively. They include Tropical Boubou *Laniarius aethiopicus,* Black-crowned Waxbill *Estrilda nonnula*, Mackinnon's Shrike *Lanius mackinnoni* and White-browed Robin-Chat *Cossypha heuglini* and eleven and five typical Grassland species (G) from riverside and impact areas sites recorded respectively including Common Fiscal *Lanius collaris* and Croaking Cisticola *Cisticola natalensis*. This signifies the diversity in adaptation to the habitat types within the project area.

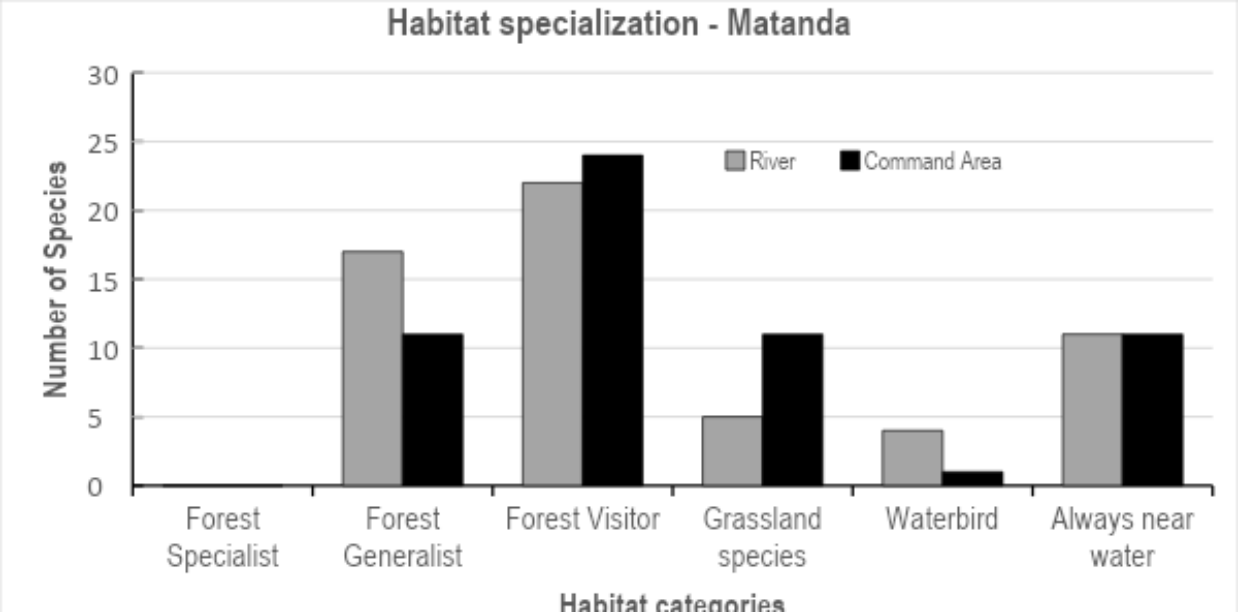


Figure 5-23: Birds Habitat specialization in the proposed Matanda Irrigation Scheme command area

Migratory species

The study was done in the month of November - December 2019, which is part of the migration season. In this period, most of the migrants, whether Palearctic or Afro-tropical, are still around. The Palearctic migrants recorded were Yellow Wagtail *Motacilla flava*, European Bee-Eater *Merops apiaster* and Common Sandpiper *Actitis hypoleucos*. Afro-Tropical migrants included White-throated Bee-Eater *Merops albicollis*, Red-billed Quelea *Quelea quelea* Red-headed Quelea *Quelea erythrops* and Grey-backed Fiscal *Lanius excubitoroides.* There were three migrants from the riverside and seven recorded from the impact area (Figure 5-31).

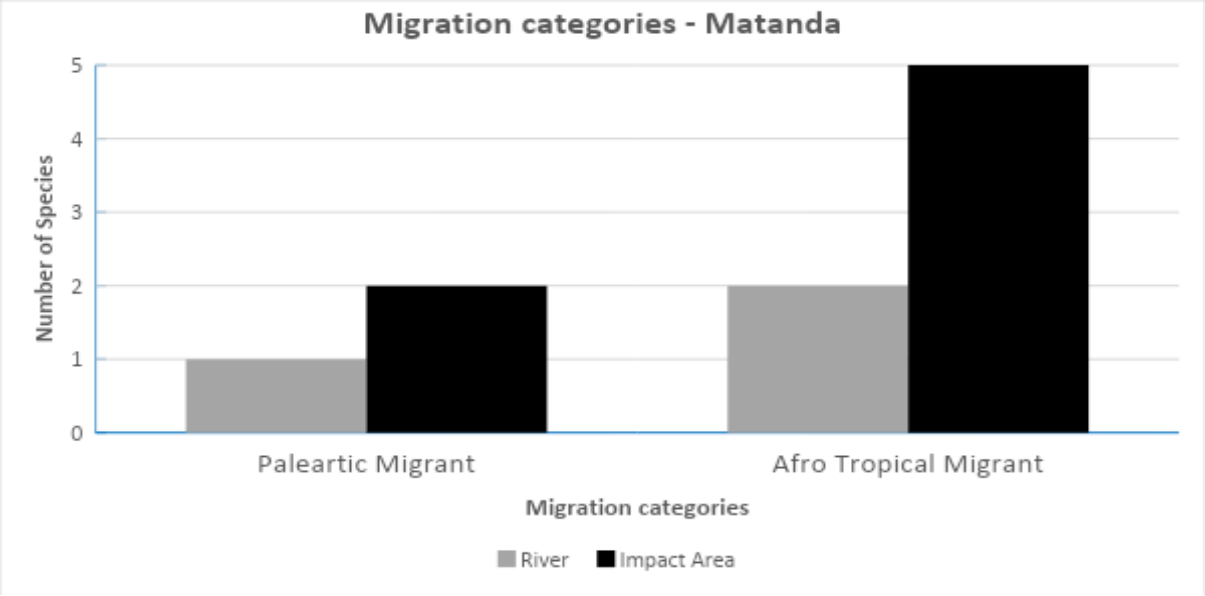


Figure 5-24: Migration categories of birds in Matanda

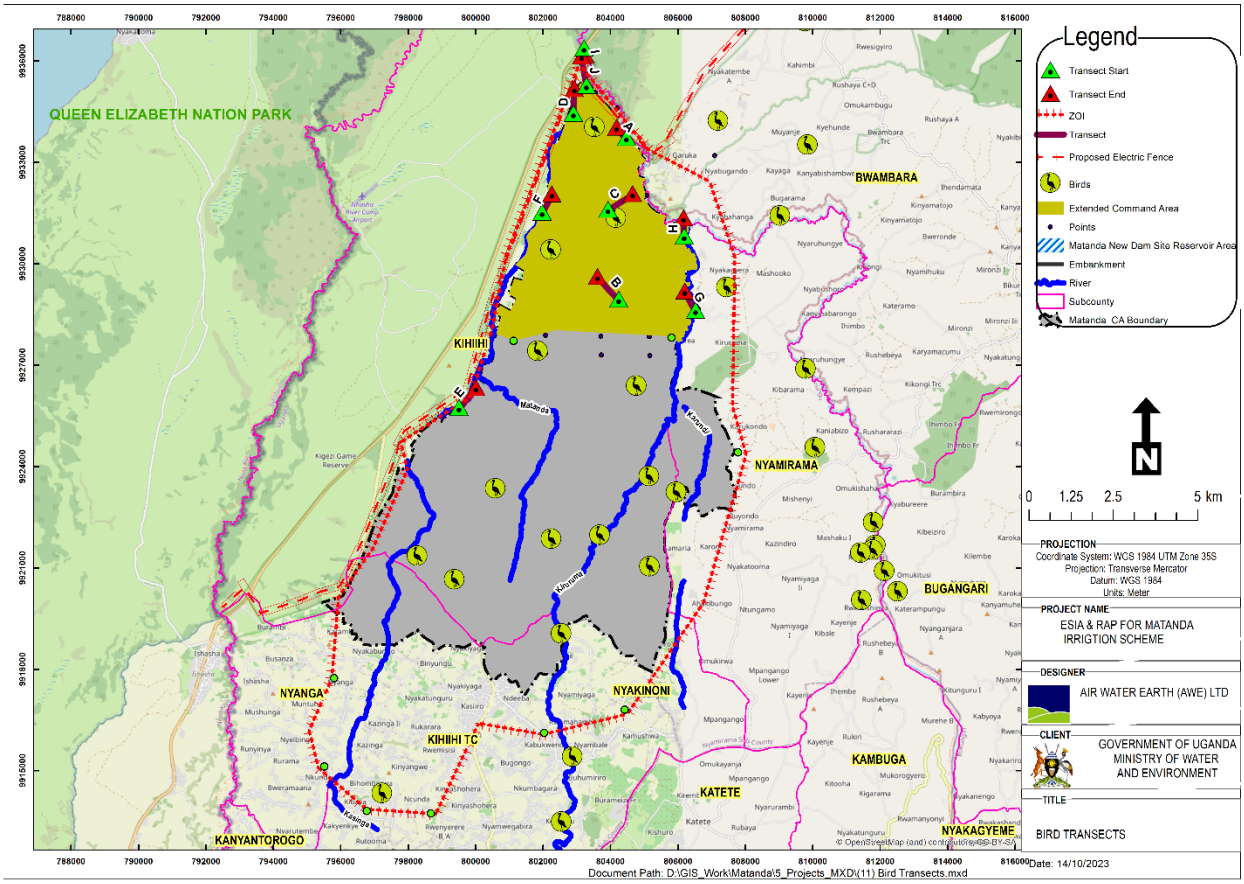


Figure 5-25 Birds survey sites for the proposed Matanda Irrigation Scheme command area extent.

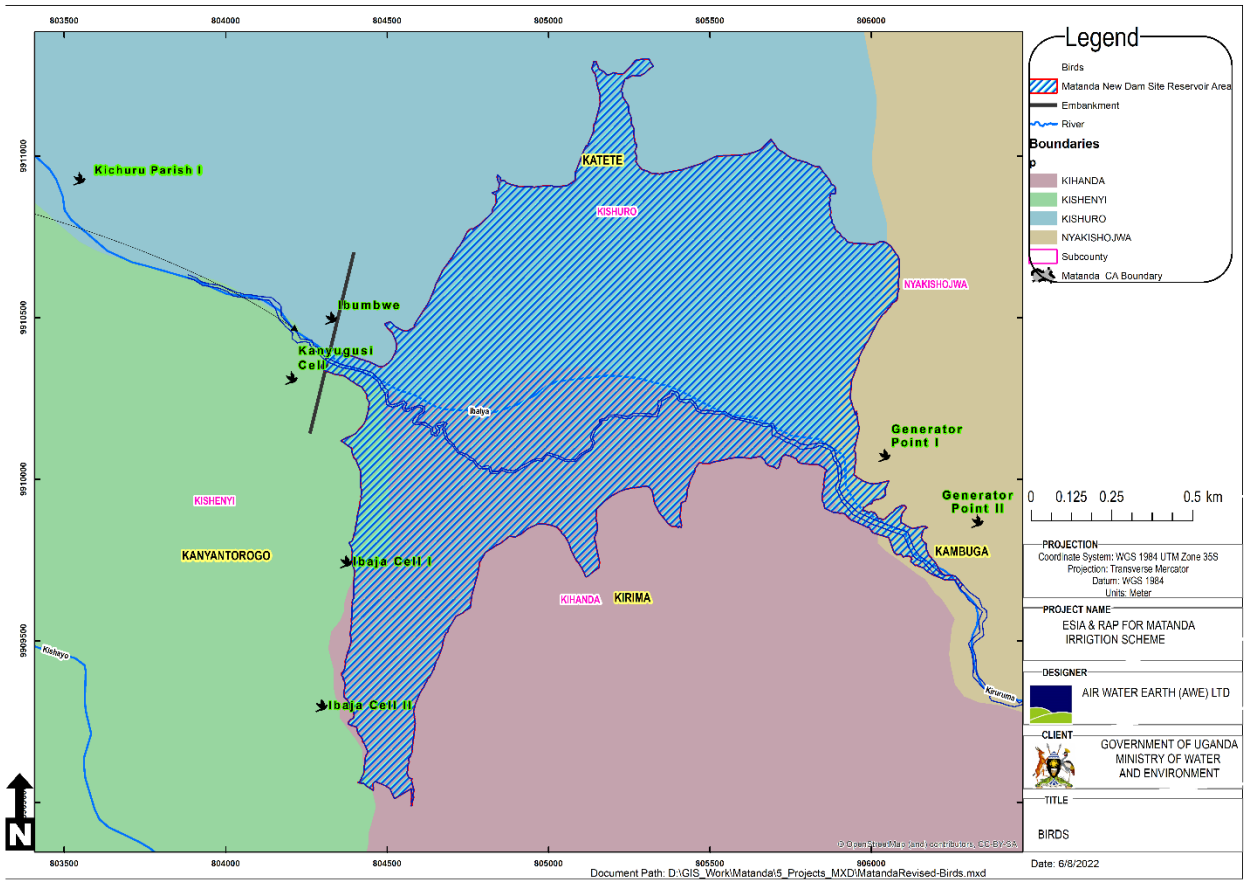


Figure 5-26: Birds survey sites for the proposed Matanda Irrigation Scheme near the dam site

These findings imply that the project area is in terms of birds dominated by species with a wide range of habitat preference. Additionally, the presence of sufficient green cover attracts species that also have utilities in the forest ecosystem supporting the need to maintain green cover along the river.

Species of conservation concern

There was no record of species in the category of Critically Endangered (CR), however, there was one Endangered species (EN) at both global and national categorisation but regionally Near Threatened (NT). This is the Grey crowned crane *Balearica regulorum*. The species is known to be widely distributed in the project area and across Uganda but with dwindling numbers mainly due to wetland habitat loss occasioned by the ever-expanding agriculture and infrastructure. It breeds along the peripherals of dense papyrus wetlands and mainly feeds in paddy areas but recently adopting relatively drier areas. The other species of conservation concern (Regional Responsibility) are Cinnamon-chested Bee-Eater *Merops oreobates* and Grey-capped Warbler *Eminia lepida*. Water withdrawal will not impact these species since they are widely distributed in the project area and across Uganda. They are classed R-RR species meaning that the responses to their conservation lie almost entirely to the East African region.

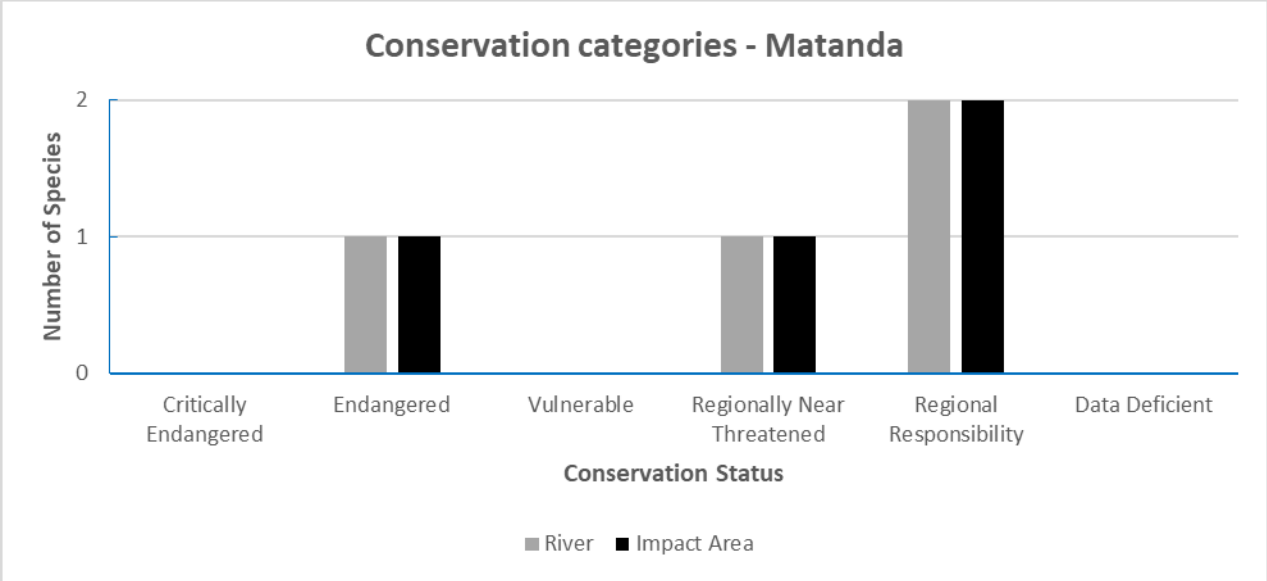


Figure 5-27: Conservation status of birds in Matanda

Upper river section of Matanda

Species diversity and relative abundance

The river edges of about 5m from the water still have some natural vegetation. However, beyond that, the sites have been modified for mostly subsistence agriculture. There are many woodlots, especially eucalyptus species. Further outwards, the area that would be impacted is dominated by subsistence agriculture and settlement. Along the river, the surveyed sites registered an average of 30 species per site while the impact area registered 22 species per site on average (Appendix E). The most abundant species in the river sites included LEAF-LOVE *Pyrrhurus scandens* (5.60), COMMON BULBUL *Pycnonotus barbatus* (5.2), Speckled Mousebird *Colius striatus* (4.40) and Grey-capped Warbler *Eminia lepida* (4.6) while in the Impact area was dominated by COMMON BULBUL *Pycnonotus barbatus* (6.0), BRONZE MANNIKIN *Lonchura cucullata* (5.43), ARROW-MARKED BABBLER *Turdoides jardineii* (4.57) and SPECKLED MOUSEBIRD *Colius striatus* (4.86).

Habitat specialization

The transects were five along the river and seven in the impact area. The most common features along the river were degraded river edges, natural vegetation mostly of shrubs and swamp plain which has been converted into paddy rice fields. Further off the river (likely impact areas), were dominated by subsistence agriculture of mostly coffee-banana plantations, maize fields, sweet potato and beans gardens. Given the characteristics of the habitat, the species expected are of mixed habitat preference. No forest specialist (FF) was recorded from the site. The most dominant category was the forest visitors (f) that recorded 21 species, with 17 species recorded near the river and 16 from the impact area followed by birds that are always near water (w) that recorded 18 species with 17 and 14 species respectively. The (Table 5-15) shows common water birds seen during the survey. Examples of forest visitors include Klaas' cuckoo *Chrysococcyx klaas*, White-browed robin-chat *Cossypha heuglini* and Tropical boubou *Laniarius aethiopicus* while those always

found near water includes Holub's golden weaver *Ploceus xanthops*, Winding cisticola *Cisticola galactotes* and Black-headed Heron *Ardea melanocephala*. In terms of habitat sensitivity, eight and ten species belonging to Forest Generalist (F) were recorded from the river sites and impact area respectively. They require forests for them to thrive and yet the forests are disappearing. They include Red-headed lovebird *Agapornis pullarius*, Ross's turaco *Musophaga rossae* and Northern puffback *Dryoscopus gambensis*. The current trend of increased forest degradation will hugely affect this category of birds.

Table 5-16 Some of the typical water-bird species seen

Atlas No.	Common name Scientific Name (Alternative Name)	Class	Total seen
21	Little egret *Egretta garzetta*	W	4
26	Black-headed heron *Ardea melanocephala*	w	15
29	Yellow-billed stork *Mycteria ibis*	W	2
39	Hadada ibis *Bostrychia hagedash*	w	25
42	Sacred ibis *Threskiornis aethiopicus*	W	2
185	Grey crowned crane *Balearica regulorum*	CR, R-NT, W, G	10

Migratory species

The survey was conducted during the month of April. This is off the main migration period meaning most of the migrants were not present. No Palearctic migrant was recorded while only three Afro-tropical species were recorded. Afro-Tropical migrants included BLACK KITE *Milvus migrans*, WOODLAND KINGFISHER *Halcyon senegalensis* and GREY-BACKED FISCAL *Lanius excubitoroides.*

Species of conservation concern

Species of conservation concern were classified according to their conservation status (global IUCN conservation status, regional conservation status and Uganda national conservation status). There was no record of species in the category of Critically Endangered (CR), however, the Grey crowned crane *Balearica regulorum* was the only Endangered species (EN) at both global and national categorisation but regionally Near Threatened (Appendix E). The other species of conservation concern (Regional Responsibility) are Cinnamon-chested Bee-Eater *Merops oreobates*, Grey-capped Warbler *Eminia lepida* and Spot-flanked barbet *Tricholaema lachrymose*. Water withdrawal will not impact these species since they are widely distributed in the project area and across Uganda.The classed R-RR species means that the response to their conservation lies almost entirely to the East African region.

Ntungwe - Kiruruma section

Species diversity and relative abundance

The sites have been highly modified and mostly under subsistence agriculture. At the time of the studies, the sites had a mix of grazed fallow, eucalyptus plantation, gardens of cassava and banana, freshly dug garden especially those at the river confluence. Some of the riverbanks had been developed providing recreational services such as lodges. However, in areas adjoining the Protected Areas, thick vegetation of forest and

undergrowth are present. Others are more open vegetation, grassland and riverine forest vegetation. These therefore presented birds' diversity of 24 to 45 species with average species of 32 along the river and 23 in the community gardens. The COMMON BULBUL *Pycnonotus barbatus* and BLUE-SPOTTED WOOD DOVE *Turtur afer* registered the highest relative abundance of 5.125 and 4.625 respectively. Some of the typical forest generalists are in table Table 5-17 below.

Table 5-17: Typical forest generalists

Atlas No.	COMMON NAME Scientific Name	Habitat class	Classification
109	LIZARD BUZZARD Kaupifalco monogrammicus	F	Forest generalist
122	LONG-CRESTED EAGLE Lophaetus occipitalis	F	Forest generalist
155	SCALY FRANCOLIN Francolinus squamatus	F	Forest generalist
268	AFRICAN GREEN-PIGEON Treron calvus	F	Forest generalist
270	TAMBOURINE DOVE Turtur tympanistria	F	Forest generalist
271	BLUE-SPOTTED WOOD DOVE Turtur afer	F	Forest generalist
273	EMERALD-SPOTTED WOOD DOVE Turtur chalcospilos	F	Forest generalist
293	RED-HEADED LOVEBIRD Agapornis pullarius	F	Forest generalist
302	ROSS'S TURACO Musophaga rossae	F	Forest generalist
578	SNOWY-CROWNED ROBIN-CHAT Cossypha niveicapilla	F	Forest generalist
692	GREEN CROMBEC Sylvietta virens	F	Forest generalist
723	AFRICAN DUSKY FLYCATCHER Muscicapa adusta	F	Forest generalist
781	GREEN-HEADED SUNBIRD Cyanomitra verticalis	F	Forest generalist
794	COLLARED SUNBIRD Hedydipna collaris	F	Forest generalist
796	OLIVE-BELLIED SUNBIRD Cinnyris chloropygius	F	Forest generalist

Habitat specialization

Birds recorded were classified into habitat categories based on the standard habitat classification by Bennun et al. (1996). This is to find out if the species are using the expected habitat or if they are adapting to different habitats. It shall also be noted that some species have not been classed as they use a wide range of habitats. There are also those that have been classed in more than one category. The characteristics of the habitat as described above are mixed and therefore recorded species falling in mixed habitat classification. No forest specialist (FF) was recorded from the sites. The most dominant category was the forest visitors (f) that recorded 28 species. There were 13 typical water species (W) and 9 species classed as Grassland species (G). The examples of species and their habitat classification are as in Appendix E

Migratory species

The survey was conducted during the month of August 2023. This is off the main migration period meaning most of the migrants were not present. However, we expect to have some early arrivals for both Afro-Tropical and Palearctic migrants. Only two Palearctic migrants; the MARSH SANDPIPER *Tringa stagnatilis* and COMMON SANDPIPER *Actitis hypoleucos were* recorded while six Afro-tropical species were recorded.

Afro-Tropical migrants are those that migrate within Africa, and they include included AFRICAN OPENBILL STORK *Anastomus lamelligerus,* WHITE-THROATED BEE-EATER *Merops albicollis* and RED-BILLED QUELEA *Quelea quelea.*

Estimated water consumption by birds

From the figure 1 showing habitat categorisation, water birds (those dependent on water for their daily survival) recorded the least number of four individuals along the river and only one individual within the impact area. Other species are therefore deemed as visitors to water sources for purposes of consumption. Although a wide range of species was recorded, the upper limit for water consumption is usually taken among birds of prey. For example, the average daily water consumption of a 724.9g captive common buzzard has been experimentally estimated at 31.4cc or 4.3% of its live body weight (Okoli, 2016). With relative abundances of birds ranging between 0.00-5.43 for all sites investigated, the total volume of water requirements for birds may be insignificant given their mobility and availability of other water sources. The water volume is also more than tenable within the dam area of the proposed scheme.

5.5.4 Amphibians and Reptiles Species richness and abundance

Overall, 12 species of amphibians from eight Families were recorded mostly along the river Kiruruma, while reptiles recorded 10 species representing eight Families. With a total of 364 individual amphibians recovered during three surveys of the two seasons of field data collection, this may not be exhaustive but representative. Reptiles had an overall total of 190 individuals recorded. The species were mostly recorded from fields of cultivation and near homesteads although some of these were expected to be found in the river. This was due to lack of pools of stagnant water along the largest section of the river, high velocity at which water was flowing as well as degradation along the river which reduced the potential of the area to harbor herptiles.

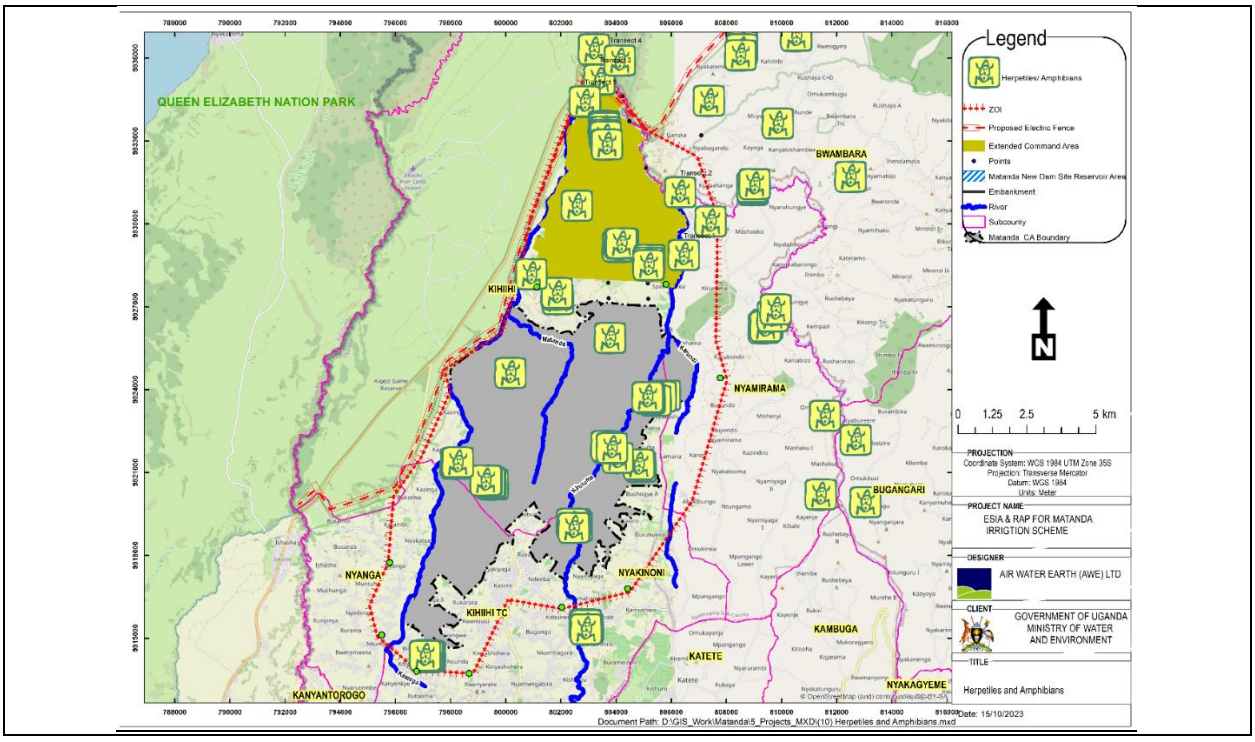
Table 5-18 Species checklist of some of the herptiles recorded from Matanda irrigation dam project area

Family	Species	Common name	IUCN Status	Encounter
Ptychadenidae	*Ptychadena mascareniensis*	Mascarene grass frog	LC	Sighted
Scincidae	*Mabuya maculilabris*	Skink	LC	Sighted
Columbridae	*Psammophis mossambicus*	Olive grass snake	LC	Reported
Agamidae	*Acanthocercus cyanocephalus*	Blue headed tree agama	LC	Sighted
Bufonidae	*Afrixalus fulvovittatus*	Banded Banana Frog	LC	Sighted
Bufonidae	*Amietophrynus gutturalis*	Guttural Toad	LC	Sighted
Bufonidae	*Amietophrynus regularis*	Common African toad	LC	Sighted
Dicroglossidae	*Hoplobatracus occipitalis*	Crowned bullfrog	LC	Sighted
Hyperoliidae	*Hyperolius cinnamomeoventris*	Cinnamon-bellied Reed Frog	LC	Sighted
Hyperoliidae	*Hyperolius kivuensis*	Kivu reed Frog	LC	Sighted

Family	Species	Common name	IUCN Status	Encounter
Hyperoliidae	*Hyperolius viridiflavus*	Common Reed Frog	LC	Sighted
Hyperoliidae	*Kassina senegalensis*	Senegal kassina	LC	Sighted
Phrynobatrachidea	*Phrynobatrachus natalensis*	Natal Padal Frog	LC	Sighted
Ptychadenidae	*Ptychadena mascareniensis*	Mascarene Grass Frog	LC	Sighted
Ptychadenidae	*Ptychadena oxyrhynchus*	Sharp nosed frog	LC	Sighted
Pyxicephalidae	*Amietia angolensis*	Angola river frog	LC	Sighted
Agamidae	*Agama agama*	Orange headed agama	LC	Sighted
Colubridae	*Phylothamnus semivariegatus*	Spotted bush snake	LC	Sighted
Elapidae	*Naja melanoleuca*	Forest Water cobra	LC	Sighted
Gekkonidae	*Hemidactylus mabouia*	Tropical House Gecko	LC	Sighted
Scincidae	*Trachylepis maculilabris*	Speckled mabuya	LC	Sighted
Scincidae	*Trachylepis striata*	Stripped mabuya	LC	Sighted
Pythonidae	*Python sebae*	Rock python	LC	Sighted
Varanidae	*Varanus niloticus*	Nile monitor lizard	LC	Sighted

LC=Least concern, IUCN=International Union for Conservation of Nature

The number of individuals for each species except the Olive grass snake was reasonably high and this was probably because the species had turned out to be resilient and adaptable to the prevailing ecological conditions associated with disturbances from human activity such as settlements and crop cultivation. Details of the survey findings are annexed in the biodiversity report. The Herpetiles were also surveyed along the river and in the wider proposed command area for the scheme.



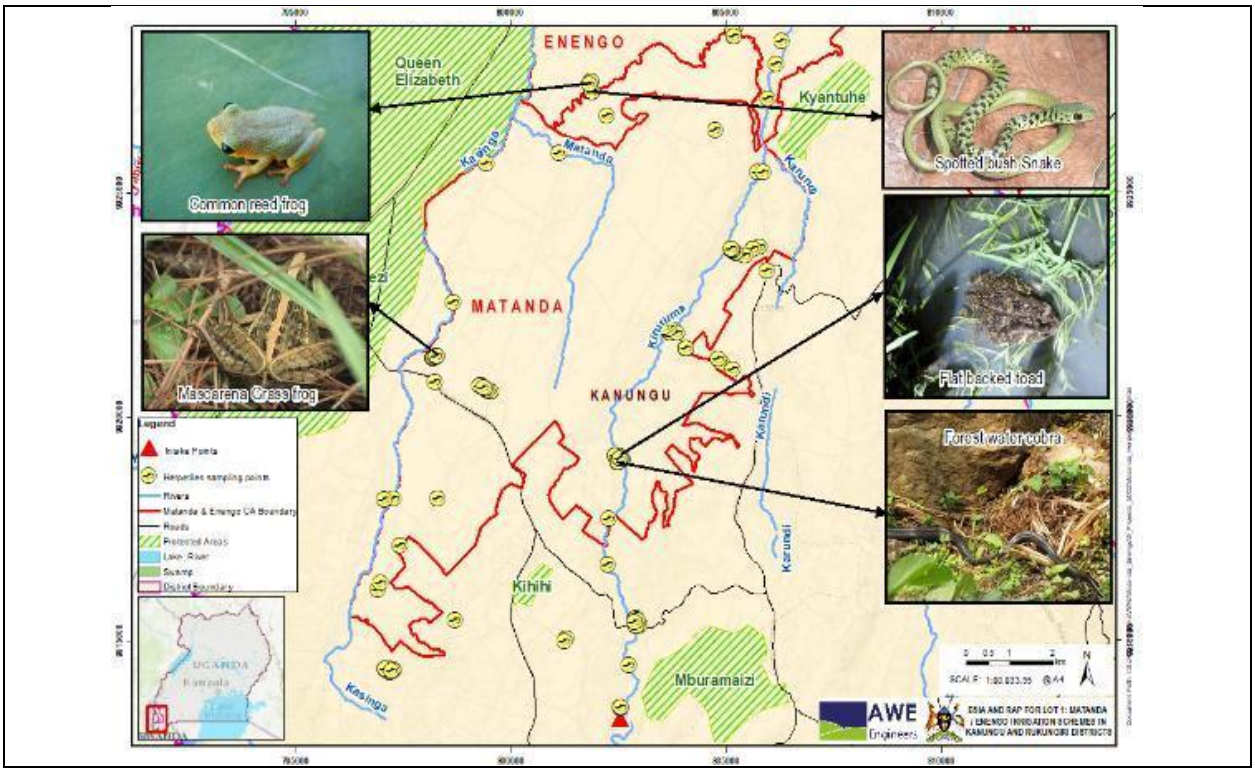


Figure 5-28: Herpetiles survey sites and pictorial in the proposed Matanda Irrigation Scheme command area

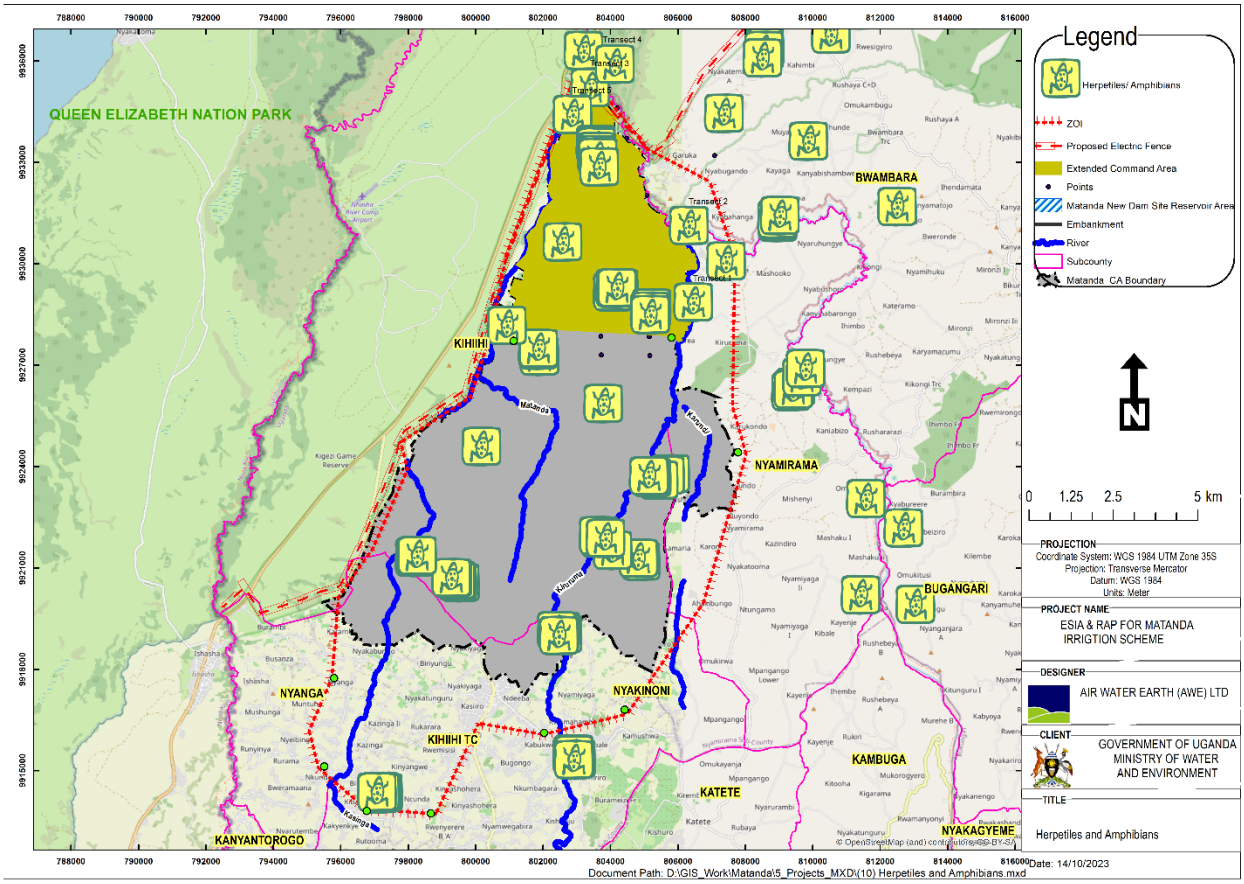


Figure 5-29 Herpetiles survey sites and pictorial in the proposed Matanda Irrigation Scheme command area extent.

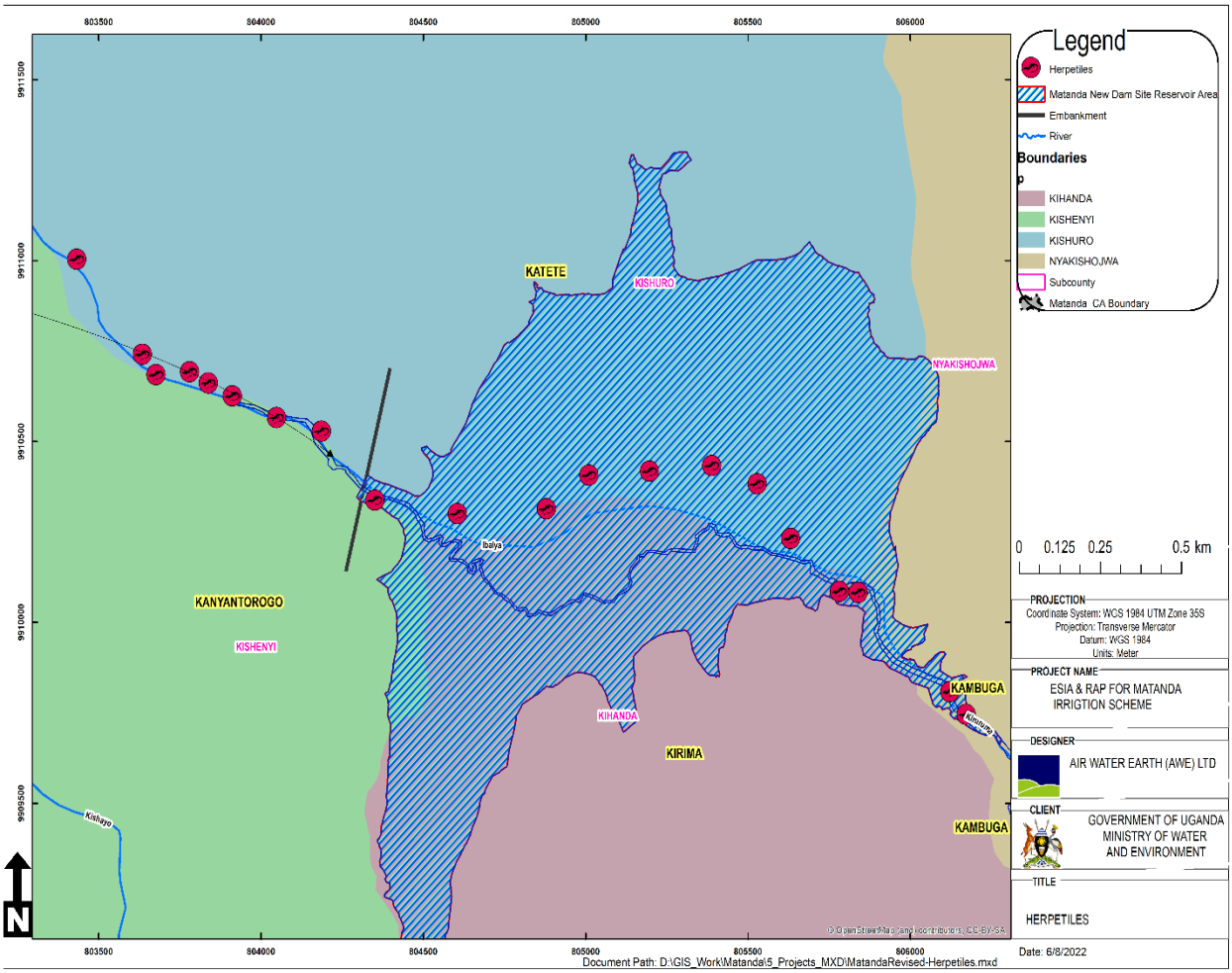


Figure 5-30: Herpetiles survey sites in the proposed Matanda Irrigation Scheme dam site

Amphibians

Overall, 146 amphibians were recorded in the project area with more records (37) encountered in Rwengoboko followed by Nyakishojwa (27), Kameme (26) and Nyamabale (21). Overall, these represented 10 amphibians, with more species recorded around Rwengoboko (Appendix E). The most common amphibians (encountered most) were *Ptychadena mascareniensis* and *Hyperolius variabilis* and were abundant in the project areas. These two are from the Family Ptychadenidae and Hyperolidae respectively. Family Hyperolidae was represented by the most species, this large family of small to medium-sized, brightly colored frogs contain more than 250 species in 19 genera with seventeen genera being native to sub-Saharan Africa (Shiotz, 1999).

(a) *Ptychadena nilotica*

(b) *Hyperolius variabilis*

Figure 5-31*: Some of the most common amphibian species recorded along the project area*

Species of conservation concern

The amphibian species recorded during the survey are considered Least Concern (LC) by the IUCN Red List of 2018 and national red list (WCS 2016) due to their wide distribution. These species are not known to be undergoing any population reduction or threat of decline in their habitat quality.

Site sensitivity

According to ARCOS (2013) 45 species are known to occur in the Albertine rift of which (25.7%) are endemic, including 11 Vulnerable (VU) and two Endangered (EN). However, none of these were recorded in the project area. Nationally, apart from *Afrixalis quadrivittatus* and *Hyperolius viridiflavus* that are listed as Data deficient (DD) other amphibian species recorded are of Least Concern (LC) conservation status (Appendix VI).

Reptiles

Reptile records totaled 48 in the project area with more records around Kameme (Appendix E), these represented nine species. However, species richness was equally high in Kameme and Kashojwa. Herptilian species diversity was highest in Rwengoboka followed closely by Kashojwa and Kameme. Reptiles were dominated by *Acanthocercus atricolis* and *Trachylepis maculirabris* which are from Order Sauria. These are mostly lizards with well-developed limbs making them more agile hence covering and colonizing more ground compared to their limbless cousins in the Order Serpentes (Cogger, 2000). Species from Order Sauria are also very adaptive with some preferring being commensal (*Agama agama* and *Trachylepis striata*) while others occupy various habitat strata (Gerlach, 2005).

Species of conservation concern

Like amphibians, reptile ecology of most Ugandan species is poorly known hence most of them listed as Data deficient (DD) or even Not evaluated (NE) by both the IUCN and the national red lists. Among the species recorded, those that have been evaluated are of Least Concern (LC) due to their wider distribution and are not known to be undergoing any population decline or threat in habitat quality by IUCN (2018). Among

reptiles, the Brown house snake and Forest cobra were evaluated as Data deficient with the rest not evaluated (WCS 2016).

Site sensitivity:
The reptiles recorded are highly mobile and quickly respond and adapt to change in land use throughout the year. However, losses of individuals will be occasioned by the operational phase while post operations adaptation is gradual. Key impacts may further arise from imbalances in the food chain especially declines in amphibian populations.

Water requirements:
The consumption, use and other water requirements for amphibians cannot be estimated as they are almost entirely dependent on water for day-to-day survival. Skin moisturisation is an important part for amphibians and therefore inadequate or inconsistency in availability is life threatening to amphibians. However, the dam area will certainly increase habitat for amphibians while a reduction in volume downstream will affect amphibian numbers.

5.5.5 Fish

River Kiruruma is endowed with a variety of fish species that thrive throughout the different river sections, especially during the wet and high-water level seasons. The dry season recorded comparatively lower numbers. A summary of the fish survey sites together with some of the fish species caught during the surveys is presented with details included in Appendix E.

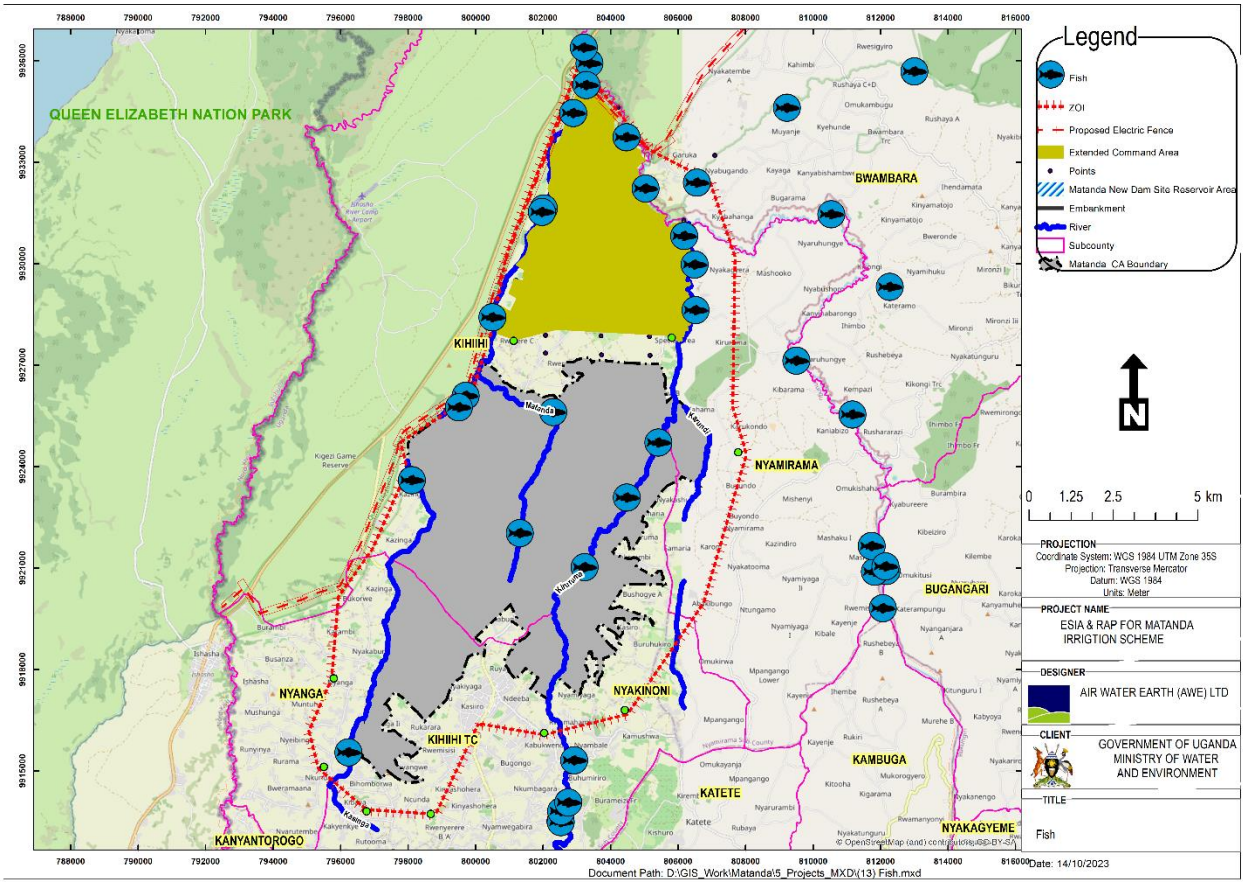


Figure 5-32: Fish and invertebrate survey sites with some encountered fish species in R. Kiruruma.

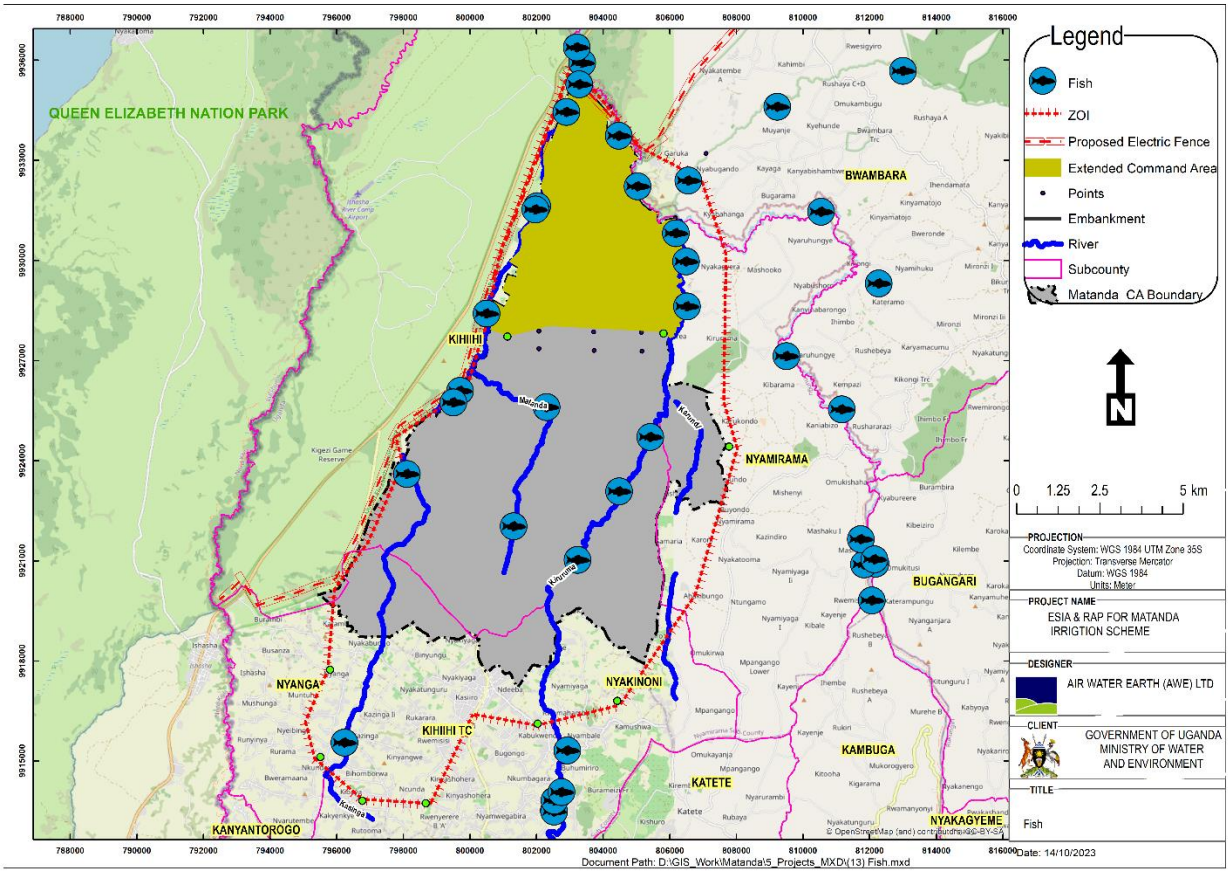


Figure 5-33: Fish and invertebrate survey sites with some encountered fish species in R. Kiruruma in the project area extent.

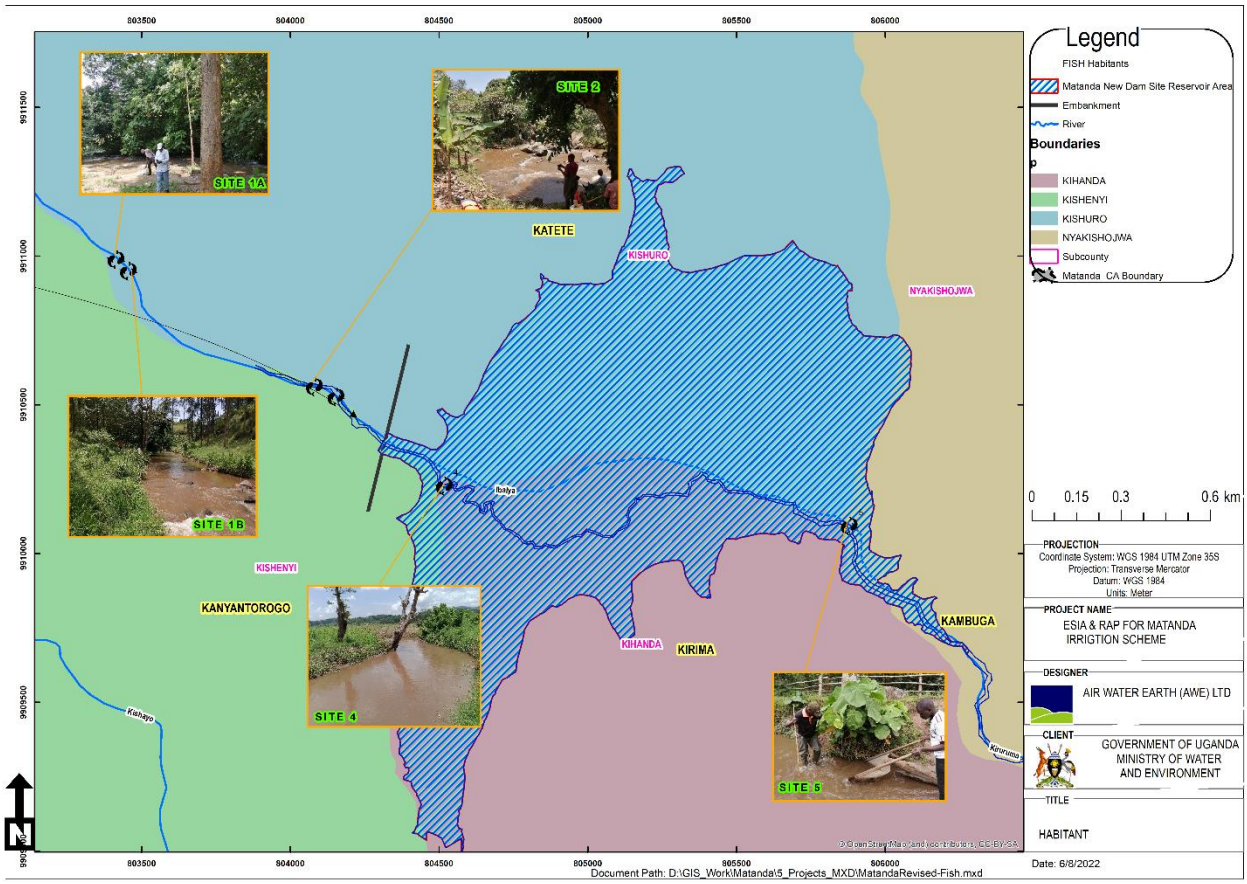


Figure 5-34: Fish and invertebrate survey sites (Upstream) with some encountered fish species in R. Kiruruma

Surveys further upstream posed safety risks due to steep riverbanks and were only done during the dry season.

Fishes - Taxa composition distribution and relative abundance during the Oct – Dec 2019 (wet season)

A total of 14 fish species from nine genera and six families were recovered around the proposed areas of development with the family Cyprinidae being the most abundant and diverse taxa. Considering the low fishing effort, 96 fish were recovered with the majority being recovered from upstream (78 fish) followed by the downstream areas (12 fish) while the mid-section of the river with only two specimens of the mountain catfish Amphilius jacksonii. The majority (>50%) of the fish species caught at Kiruruma upstream were haplochromine cichlids.

Table 5-19: The composition, abundance and distribution of fish species recovered around the three project areas.

Family	Species	IUCN Status	Kiruruma Upstream	Kiruruma Midstream	Kiruruma Downstream	Total
Mormyridae	Petrocephalus catastoma	LC			5	5
	Mormyrus kannume	LC			1	1
Cyprinidae	Barbus altianalis	LC	4		1	5
	B. jacksonii	LC			2	2
	B. kersternii	LC	15			15
	Barbus sp.	LC	2			2
	Labeobarbus sp	VU	10			10
Clariidae	Clarias gariepinus	LC			1	1
	Clarias carsonii	LC	5			5
Amphiliidae	Amphilius jacksonii	LC	4	2	2	8
Cyprinodontidae	Aplocheilichthys sp1	LC	10			10
	Aplocheilichthys sp2	LC	2			2
Cichlidae	Oreochromis leucostictus	LC	2			2
	Haplochromine sp	LC	24			24
Number of individuals (n)			78	2	12	92
Species richness (S)			10	1	6	14
Shannon Index of Diversity (H)			1.97	0	1.58	2.25
Species Evenness (J)			0.86	-	0.88	0.85
Simpson's index of diversity (D)			0.82	0	0.75	0.86

Fish species richness was highest upstream with 10 species, followed by areas further downstream with six species and only one species from the mid-section of the river. The Shannon-weaver diversity index (H') followed the same trend and no diversity at all in the midsection of the river. The species evenness, however, was highest downstream of River Kiruruma and followed by Upstream Kiruruma areas.

General Size structures, biology and ecology of dominant fish species – wet season

During this baseline survey, from River Kiruruma the Mountain catfish Amphillius jacksonii ranged from 4 – 10.5 cm FL with an average of 7.3±3.5 cm FL recovered from both Birara and Kiruruma areas of the project development. The riverine cyprinid Barbus altianalis ranged from 5 – 11.5 cm FL (Mean = 8.1±1.9 cm FL). The catfish Clarias carsonii ranged from 14 – 21.5 cm TL (Mean = 18.5±3.3 cm TL) and other smaller cyprinids B. kersternii ranged from 5.5 – 13 cm FL (Mean±2.7 cm FL). An in-depth analysis of the wellbeing and growth performance of the fish species along the project sites in River kiruruma revealed a relatively

healthy population although with slow growth. Amphilius jacksonii and Clarias carsonii exhibited positive allometric growth (b=2.7) while Barbus altianalis and B. kersternii (b>3), positive isometric growth. The relative condition factor of these fish species was as follows; Amphilius jacksonii ranging from 0.78 – 1.24 (mean of 1.01±0.19), Clarias carsonii ranging from 0.88 – 1.11 (mean of 1.00±0.09), Barbus altianalis ranging from 0.85 – 1.11 (mean of 0.99±0.07) and B. kersternii ranged from 0.87 – 1.15 (mean of 1.01±0.08).

The condition factor of these fish species recovered during these surveys can be attributed to the food/prey items ingested by the species. The fishes ingested mainly benthic aquatic invertebrates such as Ephemeropterans and detritus. It is also evident that fish always feed on the most abundant prey organisms within the water column.

The fish species comprised adult male and female individuals, several young and juveniles. Sex ratios of the Mountain catfish Amphillius jacksonii were 3:1.3 (Male: Female) with 63.7% maturity. All the Barbus altianalis were immature juveniles while the Clarias carsonii were dominated by juveniles although the adults were 2:1 (Males: Females) with 13% maturity. The rest of the fish species were juveniles. There were few breeding females and thus, the reproductive biology of fish species not extensively studied, and the presence of juveniles and few adults indicate useful nursery grounds for fish due to successful breeding and recruitment. However, there were no definite breeding grounds identified during the study, but this does not disqualify the entire area surveyed.

Fish species composition, abundance, and distribution during the dry season – April 2022

The fish species composition and numerical abundance at the sampled locations along River Kiruruma are summarized in Table 5-18 A total of four (04) fish species from three (03) genera and three (03) families were recovered around the proposed development sites with the family Cyprinidae Enteromius kersternii being the most abundant taxa.

Considering the low fishing effort, 80 fish were recovered with the majority being recovered from upstream at site 5 around the generator point (39 fish) followed by site 1, downstream areas (13 fish), site 4 at the confluence (12 fish), and least were at the mid-section of the river at sites 2 and 3.

In terms of numbers, the majority (>50%) of the fish species caught at Site 5 (further upstream) where the Cyprinid Enteromius kersternii nearly the only fish caught (Table 5-18) while in terms of weight, the African catfish Clarias gariepinus was the most important fish species also recorded at site 5 (Table 5-19).

In terms of species richness, site 1 (downstream areas) had the highest number of species (04) while the least were recorded from site 4 at the confluence with only one species. The other sites had an equal number of species richness (two species) but not necessarily similar species. Unlike the numerical abundance, the Shannon-weaver diversity index (H') was highest downstream and no diversity at all at site 4 around the confluence. Similarly, species evenness followed the same trend as the diversity.

Table 5-20: The composition, abundance (numbers), distribution and biological indices of fish species recovered around the sampled along River Kiruruma, April 2022

Family	Species	IUCN Status	Site 1	Site 2	Site 3	Site 4	Site 5	Total
Cyprinidae	Enteromius kersternii	LC	7	8	6	12	38	71
Clariidae	Clarias gariepinus	LC	1				1	2
	Clarias liocephalus	LC	2		1			3
Amphiliidae	Amphilius jacksonii	LC	3	1				4
Number of individuals			13	9	7	12	39	80
Species richness (s)			4	2	2	1	2	4
Species diversity (H)			1.73	0.34	0.41	-	0.11	
Species evenness (J)			0.83	0.5	0.59	-	0.17	

*LC =Least Concern according to IUCN RedList

Table 5-21: The abundance (weight) and distribution of fish species recovered around the sampled areas along River Kiruruma, April 2022

Familiy	Species	Site 1	Site 2	Site 3	Site 4	Site 5	Total (g)
Cyprinidae	Enteromius kersternii	42.4	37.8	29	63.4	258	430.6
Clariidae	Clarias gariepinus	609				1380	1989
	Clarias liocephalus	9		4.1			13.1
Amphiliidae	Amphilius jacksonii	26.4	6.1				32.5
Total		686.8	43.9	33.1	63.4	1638	2465.2

Of the four fish species recovered from these sampled locations along River Kiruruma, only one (1) fish species, the Enteromius kersternii was recovered from all the sites. Thus, there was low species overlap amongst the sites.

The mountain catfish Amphilius jacksonii was restricted to the lower reaches of the river since it was only recovered from sites 1 and 2 while the African catfish Clarias gariepinus was caught at the extreme sampled sites.

Size structures, biology, and ecology of dominant fish species

The size structure of the fish species during the April 2022 survey is shown in Figure 5-40.

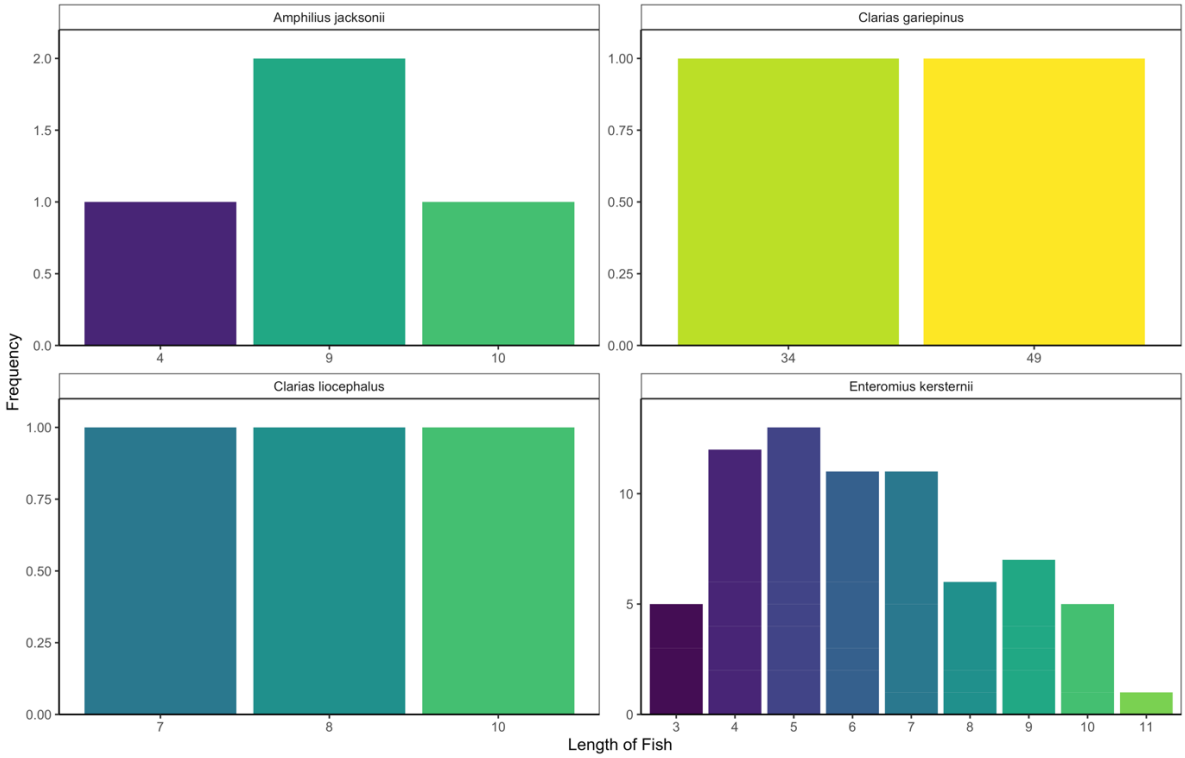


Figure 5-35: The size structure of dominant species caught at the five sites sampled along R. Kiruruma.

Fishes - Taxa composition distribution and relative abundance during the August 2023 (Dry season)

A total of 13 fish species from 10 genera and 6 families were recovered around the proposed areas of development with the family Cyprinidae being the most abundant and diverse taxa. The majority of the fish caught during this August 2023 sampling were recovered from River Kiruruma birdlife area, followed by the upstream reaches of River Kasinga and River Ntugwa. All these areas being upstream areas before the river network confluence. The majority (>50%) of the fish species caught from River Kasinga and River Kiruruma and they were dominated by the cyprinid Enteromius perince (see Table 5-20 below).

Fish species richness was highest at upstream (bridge area) on River Kiruruma with 9 species, followed by areas upstream on River Kasinga with 8 species and between 2 – 5 species from both Kasinga-Nutgwa confluence and Kiruruma-Ntungwa confluence. The Shannon-weaver diversity index (H') however was highest on River Kasinga and ten followed by River Kiruruma and so was the species evenness.

Table 5-22: The numerical abundance and distribution of fish species recovered around the sampled areas along Rivers Ntugwa, Kasinga and Kiruruma

Family	Species/Taxa	Global Status (IUCN)	National Status (Portal)	River Ntungwe		River Kasinga			River Kiruruma		
				Bridge	Bull bush camp	Upstream 1	Upstream 2	Ntungwa CONF	Bridge	Ntungwa CONF	Total
Cyprinidae	Labeo forskalii	LC	LC		6				1		7
	Labeobarbus altianalis	LC	LC	1					10	2	13
	Enteromius kersternii	LC	LC	10	9	9		12	16	3	59
	Enteromius perince	LC	DD	40	15	19		32	27	20	153
Clariidae	Clarias alluaudi	LC	LC			13	2				15
	Clarias gariepinus	LC	LC	2		1	1			1	5
	Clarias liocephalus	LC	LC		1	1	2		2		6
Amphilidae	Amphilius jacksonii	LC	LC	1	8				22	12	43
Cichlidae	Oreochromis leucostictus	LC	LC			6	10		1		17
	Pseudocrenilabrus multicolor	LC	LC			3	14				17
	Haplochromis species	-	-						1		1
Mastacembelidae	Mastacembelus franetus	LC	LC						2		2
Anabantidae	Ctenopoma muriei	LC	LC			4					4
Number of individuals (n)				54	39	56	29	44	82	38	342
Species richness (S)				5	5	8	5	2	9	5	
Shannon Index of Diversity (H)				0.80	1.41	1.73	1.20	0.59	1.64	1.15	
Species Evenness (J)				0.50	0.88	0.83	0.75	0.85	0.74	0.72	
Simpson's index of diversity (D)				0.41	0.73	0.79	0.64	0.40	0.77	0.61	

*CONF = confluence; **DD = Data Deficient; LC =Least Concern; and "-" = Not Evaluated. National Red List categories obtained from Freshwater Biodiversity Portal for Uganda (https://freshwaterbiodiversity.go.ug/)

Comparison between wet (Oct- Dec) and dry (April) season fishes

During this April survey, the Mountain catfish Amphillius jacksonii ranged from 4.6 – 10.0 cm FL with an average of 8.5±2.1 cm FL. This was lower than the average size captured during the 2019 study where relatively larger individuals of 9 – 13.4 cm FL (mean, 11.5±1.6 cm FL) were caught. Similarly, the Catfish C. liocephalus ranged from 7.8 – 10.2 (8.8±2.07 cm TL) much smaller than the earlier survey where individuals retrieved ranged from 11.2 – 17 cm TL (Mean = 13.5±3.1 cm TL). The African Catfish C. gariepinus was only caught during this survey and the individuals were large sized fishes (34-49 cm TL, 41.5±10.6 cm TL). The numerically abundant cyprinid, E. kersternii ranged from 3- 11.4 cm, mean 6.6±7.6 cm FL). These were also smaller individuals compared to the earlier sampling of October and November 2019 where individuals were ranging from 7.9 – 12.9 cm FL (Mean 10±1.9 cm FL).

The fish well being exhibited in River Kiruruma is generally good. Thus, Amphilius jacksonii and Clarias liocephalus exhibited positive allometric growth ($b<2.7$) while E. kersternii exhibited positive isometric growth ($b>3$). The relative condition for the Mountain catfish Amphillius jacksonii a relative condition of 0.99 – 1.35 (Mean of 1.04±0.21, for Clarias carsonii was between 0.92 – 1.04 (Mean of 1.01±0.03) and for the cyprinid E. kersternii, fish condition factor ranged from 0.96 – 1.02 (Mean of 1.02±0.05). The condition factor of these fish species recovered during these surveys can be attributed to the food/prey items ingested by the species. The fishes ingested mainly benthic aquatic invertebrates such as Ephemeropterans and detritus. It is also evident that fish always feed on the most abundant prey organisms within the water column.

The fish species comprised both adult male and female individuals, several young and juveniles. There were few breeding females and thus, the reproductive biology of fish species not extensively studied, and the presence of juveniles and few adults indicate useful nursery grounds for fish due to successful breeding and recruitment.

Conservation concern

This baseline survey recovered several fish species which are clearly riverine fish species, potamodromous and migratory fishes. Majority of the fish species recovered are of Least Concern (LC) according to the IUCN Red List data, in relatively good condition and comprising majorly juveniles and few adults' populations feeding on macroinvertebrates. On the other hand, according to the IUCN Red List data, Labeobarbus sp. (formerly genus Varicorhinus) within the Mount Rwenzori foothills is ranked as Vulnerable (VU) due to its restricted habitat range. This genus was recovered in the river Kiruruma. Migratory routes of the species recovered in the survey can be further established through comprehensive studies that may require tagging of a few individuals from the different species.

Moving further downstream, there was an increase in species recovery and restricted range. As a result, each fish species has evolved to fit into a specific niche throughout the river channels studied. Season and sample period may have contributed to the failure to collect mature breeding females. The presence of young, on the other hand, implies spawning individuals.

Community fisheries

There is no commercial fisheries and potential sites seen within the R. Kiruruma during the survey but rather random hook and basket fishing mainly undertaken by children. However, with the introduction of the dam, fisheries expansion and promotion is seen as a key activity for potential livelihoods improvement. However, this may not necessarily be promoted under the irrigation scheme.

Macro-invertebrates

Macro-invertebrates – Ephemeroptera, Plecoptera and Trichoptera (EPT) and Total taxa indices – wet season

During this baseline survey, the Ephemeroptera, Plecoptera and Trichoptera (EPT) indices recovered from upstream, midstream and downstream of the Kiruruma sampled sites were 0, 2, and 0. Because of the high-water levels during both October and December 2019 sampling, the only successful site was the midstream section while others were not feasible sampling macro habitats. The total taxa indices recovered from upstream, midstream and downstream of the Kiruruma sampled sites were 0, 6, and 0 at the sampled study locations (Note that 0 taxa abundance does not indicate absence of macro invertebrates but rather no available data). The macroinvertebrates of EPT taxa formed the basis of the total invertebrate community in the sampled section of the river.

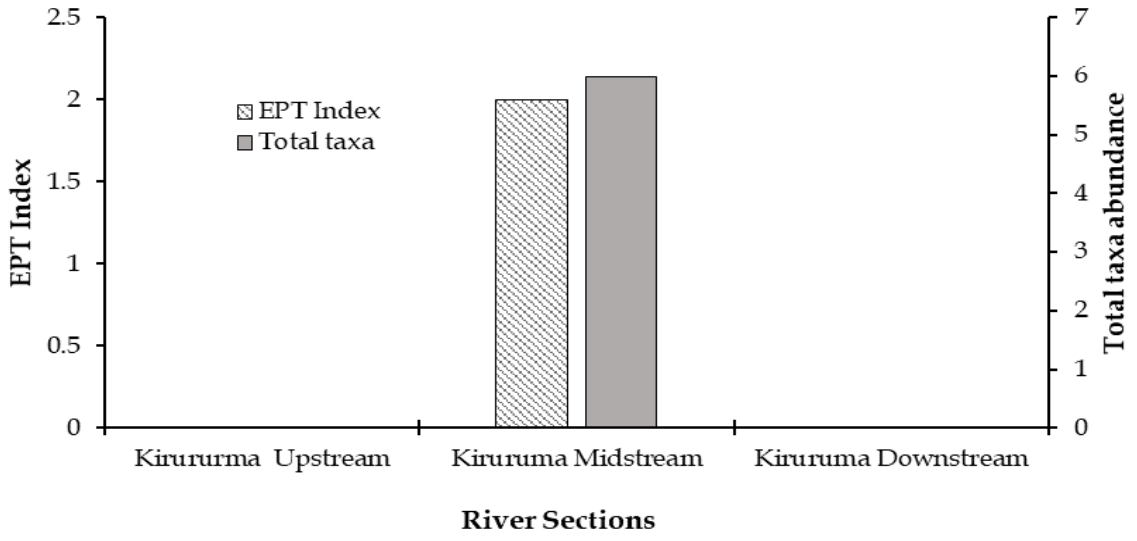


Figure 5-36: Ephemeroptera, Plecoptera and Trichoptera (EPT) indices and Total taxa indices at the project area.

Macro-invertebrate composition, abundance and distribution for both R. Kiruruma – wet season

The EPT with relatively high abundance (1 to 9 individuals/m^2), was found to dominate in all the sites upstream of river Kiruruma. The benthic invertebrates recovered were mainly the Ephemeroptera genus

Tricorythus and Trichoptera genus Cheumatopsyche. None of the EPT taxa was found in at least two of the rivers during this baseline survey. There was no clear trend in the abundances of the macroinvertebrate organisms during this baseline survey.

Table 5-23 Macroinvertebrate's composition, abundance and distribution at River Kiruruma study locations, October and December

Broad taxa	Family	Genus	Kiruruma Upstream	Kiruruma Midstream	Kiruruma Downstream
Ephemeroptera	Caenidae	Caenis	-	0	-
	Baetidae	Baetis	-	0	-
		Cloeon	-	0	-
	Tricorythus	Tricorythus	-	10	-
	Heptagenidae	Afronurus	-	0	-
	Leptophlebidae	Euthraurus	-	1	-
	Ephemerythidae	Ephemerythus	-	0	-
Trichoptera	Hydropsychidae	Hydropsyche	-	0	-
		Cheumatopsyche	-	0	-
		Amphipsyche	-	0	-
Odonata	Libellulidae		-	0	-
Diptera	Chironomidae		-	0	-
	Simulidae	Simulium	-	1	-
	Tipulidae	Tipula	-	1	-
Coleoptera	Elmidae	Ancyronyx	-	1	-
		Neoelmis	-	7	-
		Stenelmis	-	0	-
Oligochaeta			-	0	-
Richness (S)			-	6	-
Shannon Index of Diversity (H')			-	1.31	-
Evenness (J)			-	0.72	-
Simpson Index of Diversity (D)			-	0.65	-

Note: (-) does not indicate absence of the taxa, however, there was no data collected from the respective stations/sites along the rivers while (0) indicates absence.

Ephemeroptera, Plecoptera and Trichoptera (EPT) and Total taxa indices of dry season vs wet season

The Ephemeroptera, Plecoptera and Trichoptera (EPT) and Total taxa indices in the five sampled sites were 7, 8, 4, 7 and 8 for the Sites 1, 2, (downstream) 3, 4 (mid-stream) and 5 (upstream) respectively. These were quite high, more than twice as high in all the sampled sites as that recorded the December 2019 sample (s). In contrast to the December results, the EPT indices recorded from upstream, midstream, and downstream

of the river Kiruruma were respectively 0, 2, and 0. The current results are attributed to the receded water volumes that could enable accessibility to the actual river channel, and to the riffle, rocky sites which are the preferable habitats for these organisms (Miller, 2011; Stark et al., 2001). Such sites were otherwise unreachable for sampling in the first surveys of October and November 2019 subject to flooding in the wet season where the only successful site was the midstream section while others were not feasible for sampling macro habitats.

Macroinvertebrate composition, abundance, and distribution – Dry season (April)

A high diversity of the benthic macroinvertebrates comprising 30 taxa from 9 groups of Venerida (Bivalvia), Ephemeroptera, Trichoptera, Odonata, Diptera, Hemiptera, Coleoptera, Lepidoptera and Plesiopora (Oligochaeta) were recovered. The genera recovered during this survey included Pisidium; Caenis, Afronurus, Euthraulus, Tricorythus, Dicercomyzon, Ephemerythus, Cheumatopsyche, Hydropsyche, Lepidostoma, Anisocentropus, Crenigomphus, Zygonyx, Pseudagrion, Limnophila, Limonia, Tipula, Simulium, Atherix, Laccocoris, Nepa, Ancyronyx and Petrophila. These were from also were Families: Baetidae, Chironomidae, Elmidae, Dytiscidae, Scirtidae, Gyrinidae and one Class, the Oligochaeta (Table 5-24).

Table 5-24: The composition, abundance and distribution of macroinvertebrates recovered from the sampled sites along River Kiruruma during the April survey.

Recorded taxa	Sampled sites					Overall total	Relative abundance
Bivalvia	Site 1	Site 2	Site 3	Site 4	Site 5		
Pisidium	1	0	0	0	0	1	0.2
Ephemeroptera							
Caenis	0	1	0	0	1	2	0.5
Afronurus	2	3	0	1	1	6	1.9
Euthraulus	1	1	0	0	0	1	0.3
Tricorythus	11	52	2	2	21	87	27.6
Dicercomyzon	0	0	0	1	0	1	0.2
Ephemerythus	3	3	1	1	12	18	5.8
Baetidae	18	0	3	7	14	40	12.8
Trichoptera							
Cheumatopsyche	4	37	0	2	14	56	17.7
Hydropsyche	2	29	3	2	0	36	11.3
Lepidosma	0	1	0	0	5	6	1.8
Anisocentropus	0	0	0	0	1	1	0.3
Odonata							
Crenigomphus	1	1	1	1	5	8	2.6
Zygonyx	0	4	0	1	0	5	1.6
Pseudagrion	0	0	2	0	4	5	1.6
Diptera							
Limnophila	0	1	0	0	0	1	0.2
Limonia	1	1	0	0	0	1	0.3
Tipula	1	0	0	0	0	1	0.2
Simulium.	2	1	0	1	0	4	1.1
Atherix	0	1	0	0	0	1	0.2
Chironomidae	1	0	0	0	0	1	0.2
Hemiptera							
Laccocoris	0	1	1	1	4	5	1.6
Nepa	0	0	0	0	1	1	0.2
Coleoptera							
Ancyronyx	0	1	0	0	1	2	0.5
Elimidae	0	6	0	1	20	27	8.5
Dytscidae	1	0	1	0	0	1	0.3
Scirtidae	0	0	0	1	1	1	0.3
Gyrinidae	0	0	0	1	0	1	0.2
Lepidoptera							
Petrophila	0	1	0	0	0	1	0.2
Oligochaeta	0	0	0	0	1	1	0.2
Total mean recorded	44	139	11	19	101	313	
Number of taxa	14	18	8	14	16	30	
FBI	3.83	4.03	4.57	4.18	3.61	3.89	

The April (can be referred to as dry season) sampling revealed relatively high abundance of benthic invertebrates in all sites in comparison to the October and November 2019 sampling (during flooded times). The EPTs, specifically, the ephemeroptera and trichoptera, dominated the community with the respective contribution of about 50% and 31% of the total numerical abundance of the macroinvertebrates. The contributions of the remaining groups obtained during the survey ranged from 0.2 to 9.7% (Figure 4). The highest densities (i.e., 87 and 56 ind./m2 respectively) for the Trichoptera and Ephemeroptera were registered in site 2. These were also true for the densities of the other taxa in general, except the Coleoptera, Odonata and Hemiptera, whose dominance were observed in Site 5 (Figure 5).

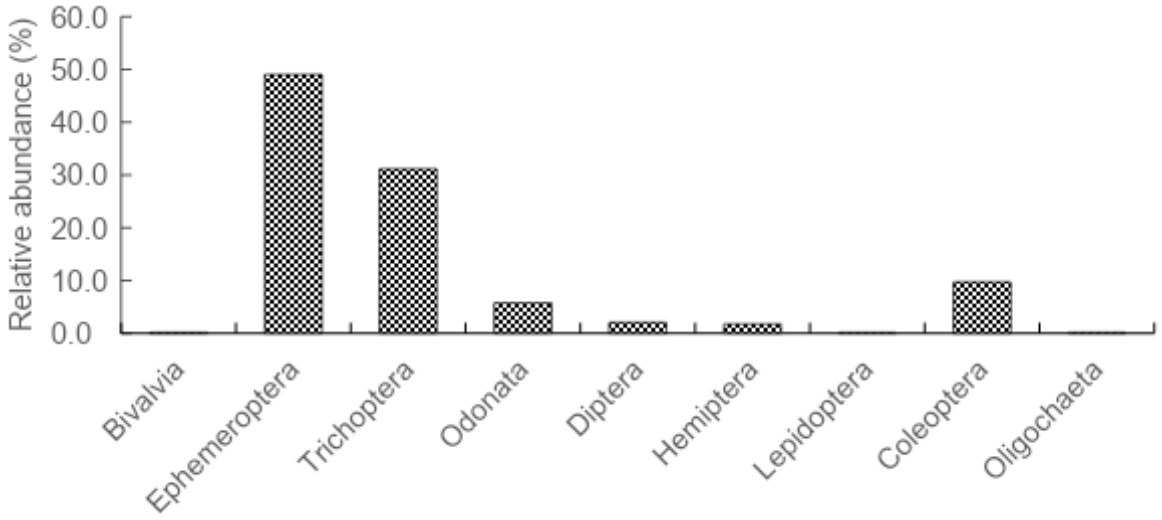


Figure 5-37 Relative abundance of the major taxa of macroinvertebrates recorded in sampled section of R. Kiruruma in April.

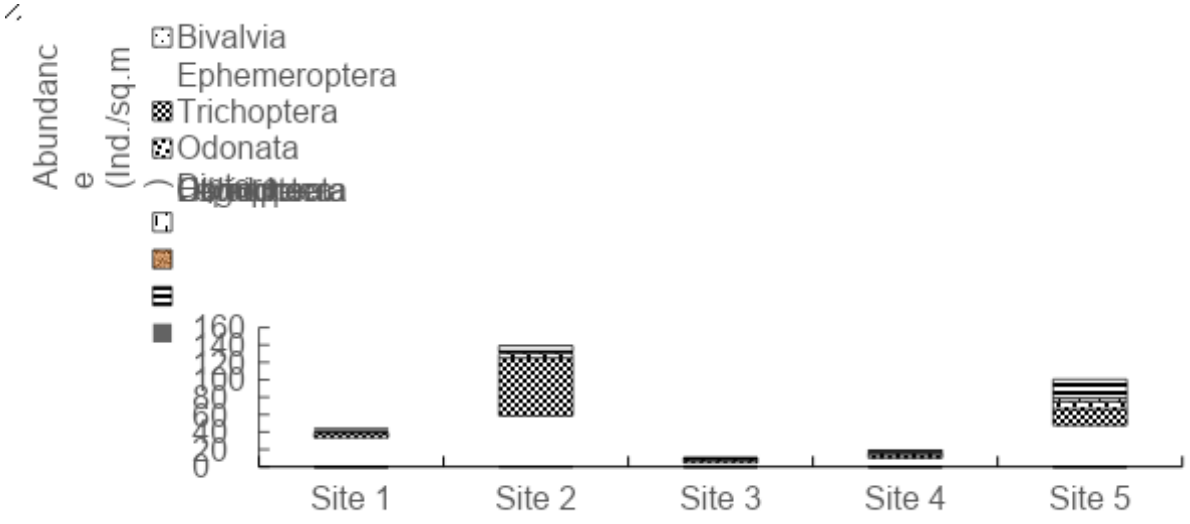


Figure 5-38: The abundance of the major taxa of macroinvertebrates recorded at the five sites sampled along R. Kiruruma in April.

The genera Tricorythus, Baetis (Ephemeroptera), Cheumatopsyche, and Hydropsyche (Trichoptera) were the majority in the sampled stretch of the river. These taxa all have well developed biting and chewing jaws

that help them shrive on the macro-organic material (like leaves). This makes EPTs very important in nutrient recycling and cleaning of the system, hence maintaining a healthy environment. These materials, the decaying leaves, were evidently abundant in the sites and particularly site 2 (Table 1). Thus, these were the dominant macroinvertebrates both in taxa richness and abundance where these EPTs indicated good water quality. These were the majority of the invertebrates during the wet season sampling of October and November 2019 sampling.

Further, the Family level Biological Indices (FBI) determined for the respective sites read 3.83, 4.03, 4.57, 4.18 and 3.61 (Table 2). These generally implied very good water quality with possible slight organic pollution (Mandaville, 2002). EPTs, together with the rest of macroinvertebrates i.e., odonates, dipterans, coleopterans etc., observed were important in supporting the Kiruruma ecosystem as food for fish and other vertebrates. For instance, the stomachs of some of the fish opened revealed insect remains, a Clarias sp. the stomach had a decapod (Potamonautes sp.) remains. Thus, suggesting a good ecological interaction of the fish and invertebrate community.

During this survey, no snails were recorded, thus no possibility of bilharzia in the vicinity. However, there is a concern for river blindness due to the presence of Simlium sp. in the samples. In addition, the one mollusc, Pisidium sp. found at one of the sites sampled could suggest probable conditions for more of the molluscs. Thus, precaution must be taken as such invertebrates are responsible for the transmission of diseases. Nonetheless, the macroinvertebrates recorded in the samples, like in the 2019 samples, were all common in the nearby rivers and others within the country.

Macro-invertebrate composition, abundance, and distribution – Dry season (August 2023)
A high diversity of the benthic macroinvertebrates comprising 37 taxa from 11 larger groups of Gastropoda, Ephemeroptera, Trichoptera, Odonata, Decapoda, Plecoptera, Diptera, Hemiptera, Coleoptera, Lepidoptera and Plesiopora (Oligochaeta) were recovered (Table 5-25 below).

Ephemeroptera, Plecoptera and Trichoptera (EPT) and Total taxa indices of dry season vs wet season

The Ephemeroptera, Plecoptera and Trichoptera (EPT) indices varied across the sample rivers and sampled sites (i.e., 3, 0, 1 depending on the river). Nonetheless, the T, Hydropsychidae Cheumatopsyche was only from the bridge area on River Kirurma.

In comparison with the April 2022 and Nov-Dec 2019 survey, the EPT was lower than the April 2022 and higher than the Nov-Dec 2022 sampling. The current results are attributed to the receded water volumes that could enable accessibility to the actual river channel, and to the riffle, rocky sites which are the preferable habitats for these organisms (Miller, 2011; Stark et al., 2001).

Table 5-25 The composition, abundance and distribution of macroinvertebrates recovered from the sampled sites along the project area extent.

			River Nkugue				River Kasinga			River Kiruruma	
Broad Taxa	Family	Genus	Bridge	Bullbushcamp	Site7	Kasingaconfl.	Upstream1	Upstream2	Ntugwaconfl.	Bridge	Ntugueconfl.
Gastropoda	Ampularidae	Pila	0	0	0	0	1	0	0	0	0
	Planorbidae	Bulinus	0	0	0	0	0	25	0	0	0
			0	0	0	0	0	2	0	0	0
Epheroptera	Baetidae	Baetis	0	1	0	0	1	2	0	0	1
		Cloeon	1	0	0	0	0	192	0	0	0
	Caenidae	Caenis.	0	1	0	0	25	0	0	0	0
	Heptageniididae	Afronurus	0	1	0	0	0	0	0	0	1
	Tricorythidae	Tricorythus	0	0	0	0	0	0	0	1	0
	Oligoneuridae	Elassoneuria	0	0	0	0	0	0	0	2	0
Plecoptera	Perlidae	Neoperla	0	0	0	0	0	0	0	3	0
Trichoptera	Hydropsychidae	Cheumatopsyche	0	0	0	0	0	0	0	1	0
	Leptoceridae	Athripsodes	1	0	0	0	0	0	0	0	0
Odonata	Gomphidae	Phyllogomphus	0	6	0	0	0	0	1	1	4
		Crenigomphus	1	12	0	0	0	0	1	0	0
	Cordulidae	Phyllomacromia	1	0	0	0	0	0	0	0	2
	Chlorocyphidae	Palatycypha	0	1	0	0	0	0	0	0	0
	Libellulidae	Zygonyx	3	0	0	0	0	0	0	4	0
			3	15	0	0	10	10	0	0	2
	Calopterygidae		0	0	0	0	0	0	0	0	1
	Coenagrionidae		0	0	0	0	5	1	0	0	1
Hemiptera	Aphelocheiridae	Aphelocheirus	0	0	0	0	0	0	0	1	0
	Naucoridae	Laccocoris	0	0	0	0	0	1	0	0	0
	Nepidae	Nepa	0	0	0	0	1	0	0	0	0
		Ranatura	0	0	0	0	0	1	0	0	0
	Belostomatidae	Appasus	2	4	3	0	3	12	0	0	4
Coleoptera	Hydrophilidae	Derallus	0	0	0	0	0	3	0	0	0
	Elmidae	Ancyronyx	1	1	0	1	0	0	0	0	0
		Elmidae	1	3	0	0	0	0	0	0	0
	Dytiscidae		0	0	6	3	0	9	0	0	0
Diptera	Chironomidae	Chironomus	0	0	0	790	6	6	1	0	0
	Syrphidae		0	0	1	0	0	0	0	0	0
	Stratiomyidae		0	0	0	0	0	2	0	0	0

Decapoda	Atyidae	Caridina	21	23	0	1	0	0	4	0	24
Hirudinea			0	0	0	0	1	0	0	0	0
Oligochaetes			2	4	1	1	1	0	1	0	2

Note: Conf =confluence

Sensitivity

The macroinvertebrate community composition, i.e., dominance by EPTs taxa such as the Ephemeroptera (e.g., genus Tricorythus, Baetis (Baetidae) and Trichoptera (e.g., Hydrosyche and Cheumatopsyche) indicate relatively intact riparian margin and good water quality. The Macroinvertebrates recorded are common ones with no special conservation concern in accordance with IUCN Red List of species.

Apparently, no snails and hence Schitosomes responsible for bilharzia are present in the proposed development area, therefore conditions that might lead to the colonization of the water by the snails must be observed. However, the density of the major EPTs e.g., Tricorythids, Baetids Hydrosyche and Cheumatopsyche shall be monitored as they will show early signs of contamination in the rivers during and after project development.

Water requirements

Any slight changes in water quality and quantity have differing impacts on the fish population within the river system. Breeding, spawning, though not demarcated, feeding, and the entire fish life require the presence of substantial volumes of water. The riverine fisheries recorded are not fished and therefore do not sustain human populations within the areas recorded. Changes in volume and quality are foreseen during the irrigation scheme project and these will impact on the fisheries but to a minimal level. Creation of the dam area will favour species of larger and slow-moving water volumes mainly species of *Clarias* while impacting species with rapid water migratory tendencies as well as those that swim against currents. Dams are usually devoid of important species of *Cichlids* and these can only be stocked after adequate aquatic studies. Hydrological values shall be those that maintain constant flow of water throughout the dry season at reasonable levels.

5.5.6 Butterflies

Species diversity and abundance

The banks of river Kiruruma are characterised by degraded riverine woodlands, agro ecosystems which are a mixture of eucalyptus plantations and cultivation sites, seasonally flooded areas, swamps and wetlands mostly converted into rice puddles, open and wooded grasslands and settlements. A total of 89 butterfly species in five families (Appendix E) were recorded in the different river sections sampled with a relative abundance of 3.6. This abundance is above the average (3) making this site stand among the rich sites in terms of butterfly species density. The species recorded included a number of habitat specific species; 2 forest dependent species, 12 forest edge/woodland species, 18 migrant species, 14 open habitat species, 4 swamp species and 38 widespread species. The survey was conducted towards the end of the wet season yielded higher species number (89) and abundance (3.6). This can be an indication that this site is a refuge to species by providing their required shelter and food when these resources are scarce elsewhere. The species that were rare and relatively rare, included *Ankola fan, Mylothris rubricosta, Acraea pharsalus, Amauris tartarea, charaxes etesipe, Charaxes numenes, Salamis parhassus, and Neptis metella.*

Species of conservation concern

All riverbanks are mainly dominated by cultivation, Eucalyptus plantations, degraded riverine woodland, fallows and bushlands. No IUCN threatened or endangered species would be impacted by the proposed activities because none of them is present in the areas covered by this project. However, some sensitive butterfly species could be disturbed especially those that are habitat specific.

Water requirements

With the exception of forest dependent and forest edge species that have a bearing on the existence of riverine forest which may be damaged during the operational phase of the irrigation scheme construction, there are no other major requirements for water under this category.

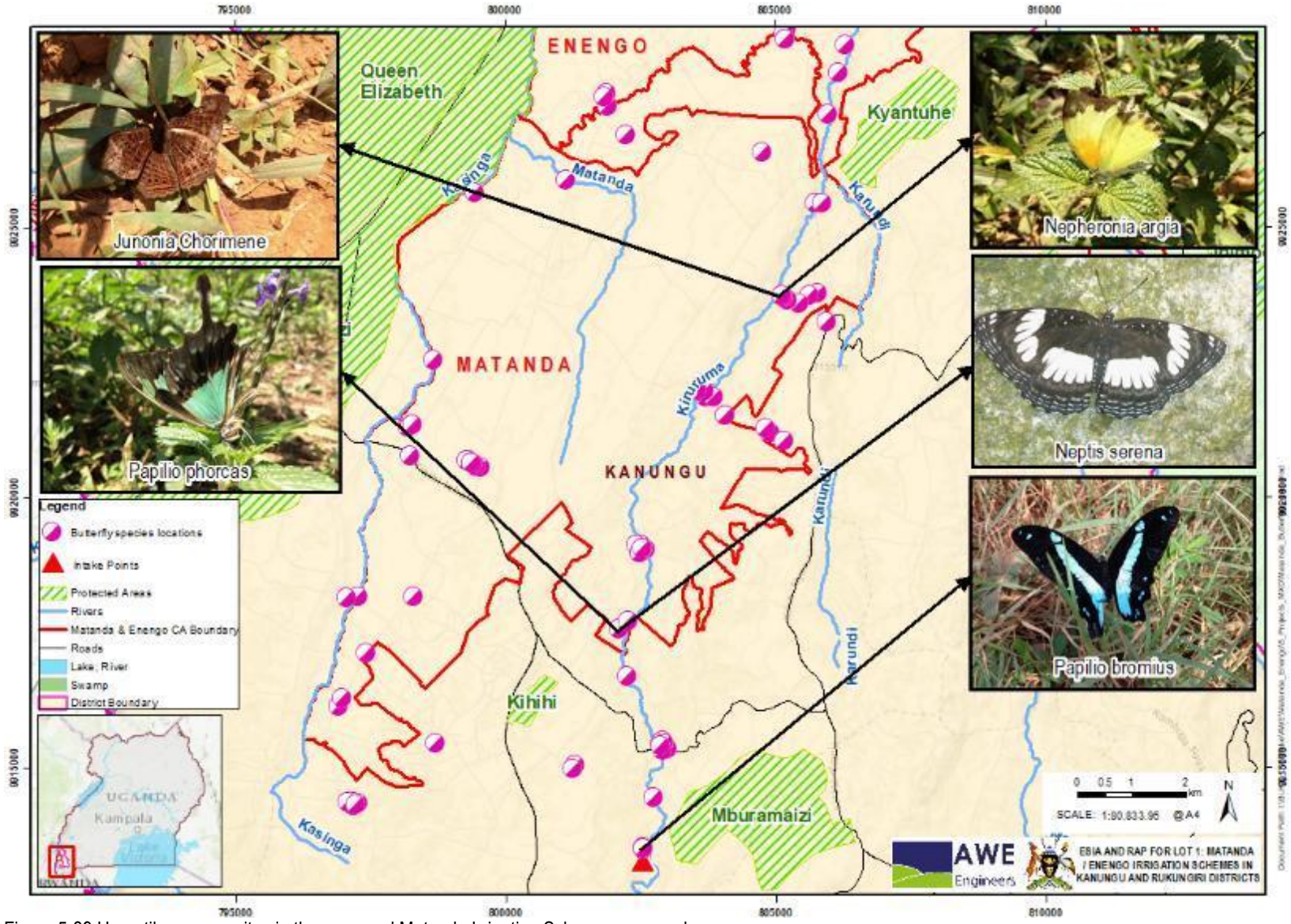


Figure 5-39 Herpetiles survey sites in the proposed Matanda Irrigation Scheme command area

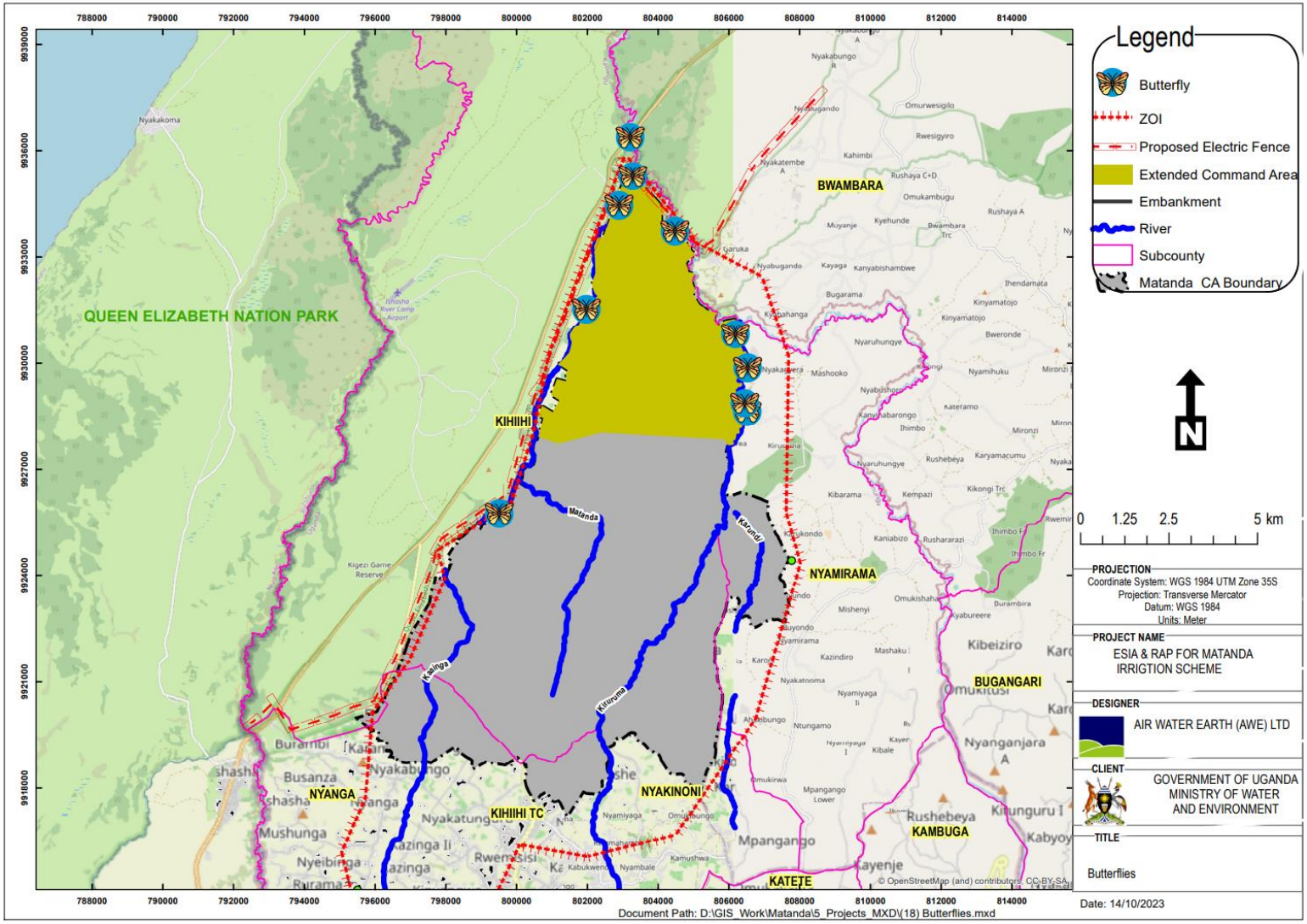


Figure 5-40 Herpetiles survey sites in the proposed Matanda Irrigation Scheme command area *extent*

To successfully monitor and measure impacts and check the success of the adopted mitigation measures thereof against this biodiversity baseline, a Biodiversity Action Plan (BAP) shall be developed.

5.5.7 The Biodiversity Action Plan

The aim of the BAP is to achieve no net loss of biodiversity in known natural habitats and net gain for species that trigger Critical Habitat by following the mitigation hierarchy, ensuring that the biodiversity is protected, enhanced and where possible implementing offsets undertaken. The BAP has been prepared as part of this ESIA and is presented in **Appendix N** of **Volume II**.

5.6 SOCIO-ECONOMIC BASELINE

This section is updated from the previous studies of 2020 to incorporate surveys of 2023 with an aim of including additional sub counties and villages previously out of scope. The purpose was to give a holistic background of the study area upon which future monitoring and evaluation of project impacts on social aspects would be measured. The consultant understands that the socio-economic baseline for the greater commend area remains the same and therefore emphasis in this assessment concentrated more on the added villages in Kihihi subcounty Kibimbiri parish. However, for a broader understanding, some villages in Nyanga and Kihihi subcounty previously assessed has been reassessed as advised by the district leadership. Figure below highlights the areas assessed in this updated version of the report.

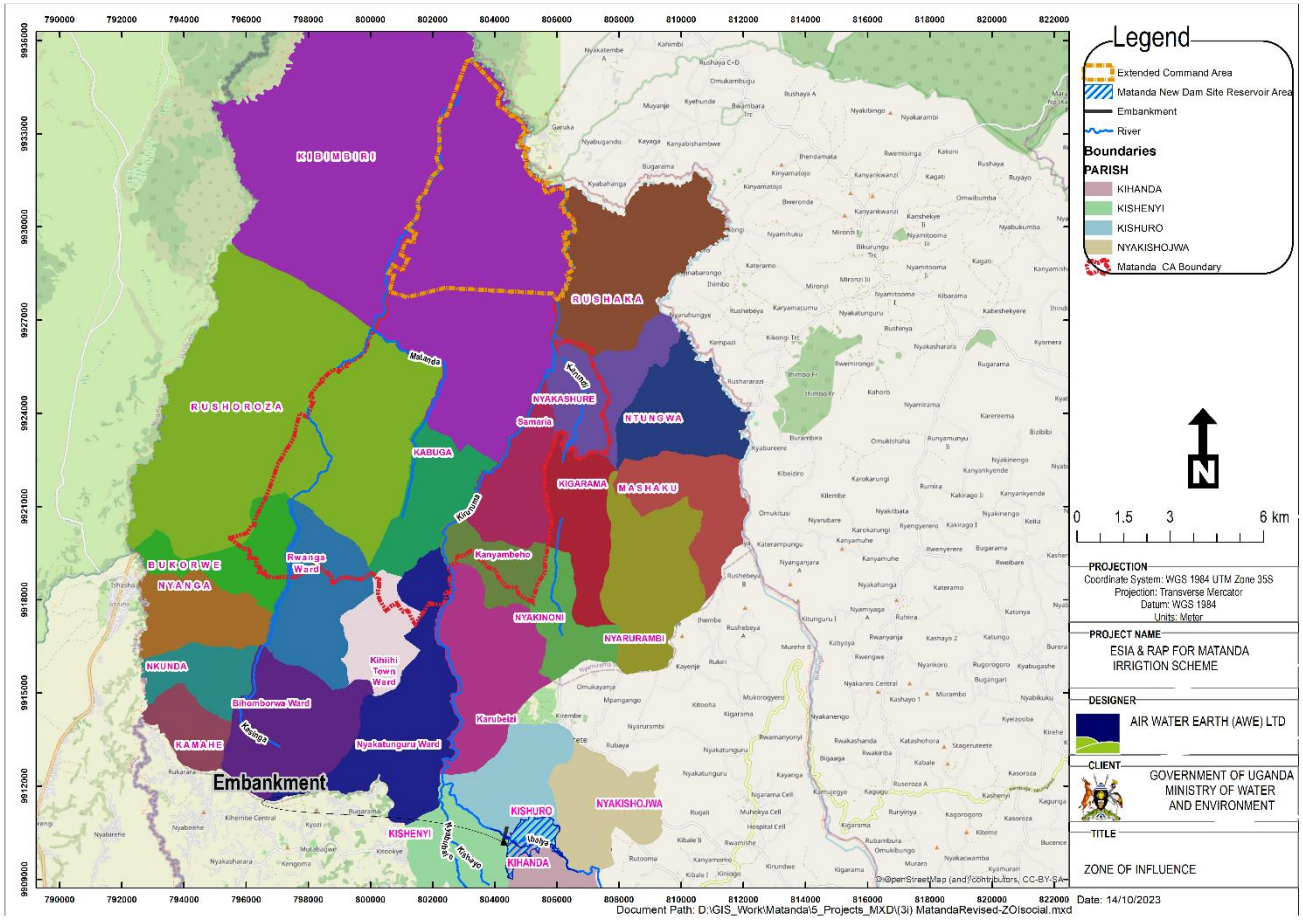


Figure 5-41 Map showing scheme command area delimited sub counties and parishes

The consultant during the updated studies triangulated various methodologies including reviewing stakeholder concerns at district, subcounty, and local council leaders' and communities' level. The stakeholder engagements aimed at debriefing the leaders on the changes in the scope and updating their views regarding the project implementation. Household data collection from the five villages undertaken purposively through the help of chairpersons, focus group discussions within the added villages, review of the new district development plans (2020-2025) and undertaking additional project area transect drive.

Findings from the five villages were incorporated in the already existing report to make a completely new revised version. For example, data generated from the additional studies were added to the existing data set and analysed once again to check for discrepancy or consistence with the original data sets.

Table 5-26 Various stakeholder engagements conducted in update.

	
Updated meeting with Kanungu District planner	Update meeting with Nyanga Subcounty leaders
	
Meeting with chairpersons of six villages	Community meeting in Bukorwe Village

5.6.1 Administrative structure in project area

Kanungu district is divided into 13 rural Sub-counties and 4 Town Councils. It is constituted of 73 parishes and 517 village councils. The district is covered by one county; Kinkizi County divided into two sub counties; Kinkizi West and Kinkizi East. The District Council is the highest political authority in the district, with 22 members under the headship of the District Chairperson. It has a technical team headed by the Chief Administrative Officer, distributed in 8 directorates and departments. Specifically, the scheme command area is located in six (6) sub counties; Kihiihi, Kihiihi Tc, Nyakinoni, Nyamirama, Nyanga, and Kanyantorogo sub counties, 22 parishes and 140 villages (Table 5-22 and Appendix B).

Table 5-27: Administrative units within the proposed Matanda Irrigation Scheme command area

DISTRICT	SUBCOUNTY	PARISH	VILLAGES
Kanungu	Kihiihi	Kibimbiri	Kiruruma B, Kiruruma A, Rusoroza, Omwirangizo, Group Farm A, Group Farm B, Rwerere B, Rwerere C, Rwerere A, Kyenyabutongo, Kameme, Matanda, Kanyinaburimano, Nyamenzi, Special area.
		Rushoroza	Kibimbiri, Kazinga Lower, Kazinga Upper, Cumbugu Tukundane, Kyakatarangi, Kashojwa, Nyarurambi Rwerere, Ibambiro
		Kabuga	Matanda I, Kayembe, Kiruruma, Bushere, Matanda Iii Kabuga
	Kihiihi TC	Rwanga Ward	Binyungu, Kazinga I, Ibambiro, Nyakatunguru, Karambi, Kazinga II, Rukarara, Muzizi, Rwemisisi, Nyakiyaga
		Nyakatunguru Ward	Bubaare, Rwenyerere, Kinyashwehera, Kiruruma, Kabukwenda, Bugongo, Ndeeba, Kamutungu, Kinyamashe, Karama, Rushenyi, Nkumbagara, Kishunju, Nyamwegabira
		Kihiihi Town Ward	Ruyayo, Nyakiyaga, Ndeeba, Kasiiro, Rutwe, Market, Bugongo, Central
		Bihomborwa Ward	Kinyashohera, Rwemisisi Kihihi Tc, Rwemisisi, Rwenyerere A, Rwenyerere B, Kazinga, Kinyangwe, Buzaniro, Bihomborwa, Ncunda, Kakyenkye, Kibaya, Rutooma
	Nyakinoni	Kanyambeho	Kasiro, Buruhukiro, Nyakayanga, Kanyambeho, Nyakahita
		Karubeizi	Buhumiriro, Muruhura, Rwamahamba, Nyambale, Kamushwa, Omukibungo Omukirwa, Rwangoboka, Nyamiyaga
		Nyakinoni	Karonde, Nyakinoni,
		Samaria	Nyakashure, Kiruruma, Samaria, Nyakarambi Bushogye A, Bushogye B
	Nyamirama	Mashaku	Rwemishinya, Mashaku II, Mashaku I
		Ntungwa	Omukishaha, Kaniabizo, Kagunga
		Nyakashure	Kahama, Samaria, Kibarama, Karoni, Karukondo
		Kigarama	Karoni, Ahakibungo, Samaria

DISTRICT	SUBCOUNTY	PARISH	VILLAGES
		Rushaka	Mashooko, Kiruruma, Nyakagyera, Nyaruhungye, Nyabushoro
	Nyanga	Bukorwe	Karambi, Kazinga, Bukorwe, Nyakashozi, Nyakabungo
		Nkunda	Nkunda, Kazinga
		Nyanga	Rutooma, Nyanga
	Kanyantorogo	Burema	Kashanda, Kitookye
		Kihembe	Kihembe Central, Kengoma, Kyozi, Nyakasharara, Rukarara, Kanyashande, Nyabirehe, Rugarama
		Nyamigoye	Kyajura, Bushoro, Ishasha., Nyabubare, Bugiri, Nyabihoko

Dam Location

The dam is located in two villages: Ibumbwe in Kishuro parish Katete subcounty and Kanyungutsi village in Kishenyi parish Kanyantorogo subcounty. The reservoir area covers 8 villages, 4 parishes and 3 sub counties as indicated in Table 5-28.

Table 5-28 Administrative units of the proposed reservoir area

Subcounty	Parish	Villages
Katete	Kishuro	Mutojo
	Nyakishojwa	Nyakishojwa
		Ibumbwe
Kihanda (formerly under Kirima subcounty)	Kihanda	Ibarya
		Nyakarambi
Kanyantorogo	Kishenyi	Kanyungutsi
		Nyambare
		Burambira

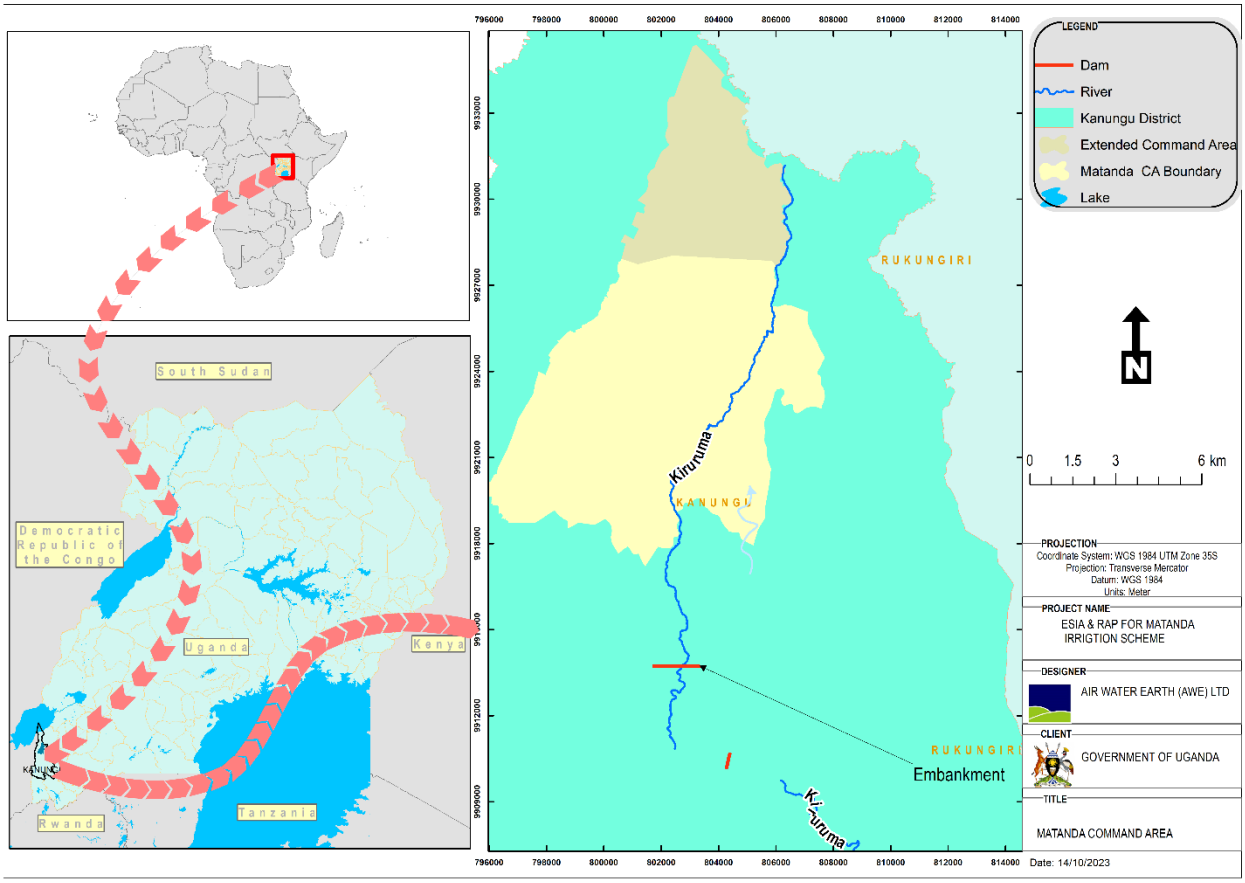


Figure 5-42: Map showing scheme command area delimited sub counties and parishes

5.6.2 Population and Demographic Characteristics

A. Population

As the district strives to achieve Economic development, issues of population size and growth shall critically be given thought. According to Uganda's Population and Housing Census (2014), the population of Kanungu was 252,144 of which 121,081 were males and 131,063 females as per the district development plan (2015/16-2019/20). The population structure significantly changed in the updated review reflecting a total population of 288,545 with male being 140,518 and female being 148,027 making a difference of 36,401 persons between the two reporting regimes. Table 5-29: below gives the summery of current population structure of the study district.

Table 5-29: Population Size for Kanungu District

Sub-County	Male	Female	Total	Sex Ratio	Land Area	Pop/ Density
Butogota T/C	5,808	5,997	11,805	94	3	3,935
Nyanga	4,124	4,371	8,495	92	26	327
Kambuga	12,209	12,952	25,161	92	72	349

Kambuga T/C	3,264	3,402	6,666	93	4	1,667
Kanungu T/C	8,372	8,857	17,229	92	45	383
Kanyantorogo	10,628	11,058	21,686	94	69	314
Katete	4,022	4,303	8,325	91	34	245
Kayonza	15,639	15,938	31,577	96	119	265
Kihiihi	10,299	10,271	20,570	98	2608	8
Kihiihi T/C	11,013	11,658	22,671	92	49	463
Kinaaba	4,528	5,169	9,697	85	37	262
Kirima	9,843	10,362	20,205	92	80	253
Mpungu	6,319	7,341	13,660	84	210	65
NYAMIRAMA	4,991	5,017	10,008	97	36	278
NYAKINONI	10,569	10,964	21,533	94	74	291
Rugyeyo	11,491	12,231	23,722	91	66	359
Rutenga	7,397	8,136	15,533	89	89	175
Total	**140.518**	**148.027**	**288.545**	**92**	**1228.28**	**235**

Source: Kanungu DDP 2020/21 – 2024/25

Communities in the project area live in relatively big household sizes. A substantial number of the respondents (46.1%) reported that their households had between 4-6 members. More than a quarter of the communities (25.6%) have families of between 7-9 members while those with 1-3 members are low (22.9%). This implies that families were assured of farm labor given their bigger family sizes. Majority of respondents (90%) were staying in privately owned houses, those in rented houses were (9.8%).

This implies that study was conducted among permanent residents with established family addresses. The added areas of assessment did not exhibit any changes as they were predominantly rural areas with most of the homesteads established permanently and therefore easy to identify and select those to be subjected a questioner.

B. Refugee populations in the District

Kanungu District is hosting Matanda Refugee Transit Centre, located at Matanda village in Kihihi Sub County. This is an exit and entry point for refugees mainly from DRC and Rwanda.

According to Kanungu Chairperson whose views are also captured in the district development plan 2020-2025, daily, Matanda Refugee Transit centre hosts 600 refugees due to tribal clashes, forced rebel recruitments, abductions and death threats. Very many refugees are settled within the surrounding communities of the border of DRC and many organizations have come in to provide Humanitarian Assistance and other services to the refugees coordinated by the Office of the Prime Minister. There is poor coordination of the Humanitarian and Development Agencies that operate in the district and this might result into duplication of services and reduce synergies.

The level of involvement of host communities in the plight of refugees is not well documented and this has led to conflicts in the host communities with refugees especially gender-based violence. In 2018/2019 a total of 406 GBV cases were handled of which 108 from refugees and 298 from the host population by Community development officers. There has been establishment of parallel refugee services and as such refugees enjoy better-equipped facilities, despite the continuous interaction and co-existence between the refugees and the communities and sharing of services.

As part of strengthening coordination enhancement, the Local Government is to lobby Office of the Prime Minister (OPM) to benefit from the Development Response to Displacement Impacts Project (DRDIP) to support District level inter-agency quarterly and review meetings, Cross Border Surveillance, Data management through dissemination of information on refugee matters, radio talk shows, and community dialogue/sensitization of Host population regarding co-existence policing.

Relationship between the temporary camp and the scheme

The temporary refugee camp has an area overing 50 ha that is in proximity to the project command area. However, this site has been excluded from the command area design to allow for the continuation of the normal transit camp activities like access to social amenities such as firewood. The project has established that the camp has an existing water source in form of motorized (piped) water source. The camp is managed by the Office of the Prime Minister and its occupation is on a temporary basis settlement to pave way for their relocation to permanent refugee camps. Their presence is determined by prevailing security circumstances in the neighbouring countries of Rwanda and D.R. Congo with the camp being vacant for most times throughout the year. The project has found out that the interaction between the communities and the temporary refugees, has to a limited extent caused social conflicts as a result of cultural differences and other social misdiminour. The project has already procured technical assistance that will collaborate with Office of the Prime Minister to minimize and where applicable, mitigate such impacts through community and refugee sensitization.

Photo 5-3:Typical nature of homesteads within the project area traversed in the updated studies.

C. Age Group of Household Heads

Findings from the socio-economic household survey showed that the average age of the household heads in both the command area and dam/reservoir area is 26-35 followed by 36-45 years. This implies that majority of the household heads are in their productive years and can therefore provide able labour force during construction and operation of the scheme, if given employment opportunities.

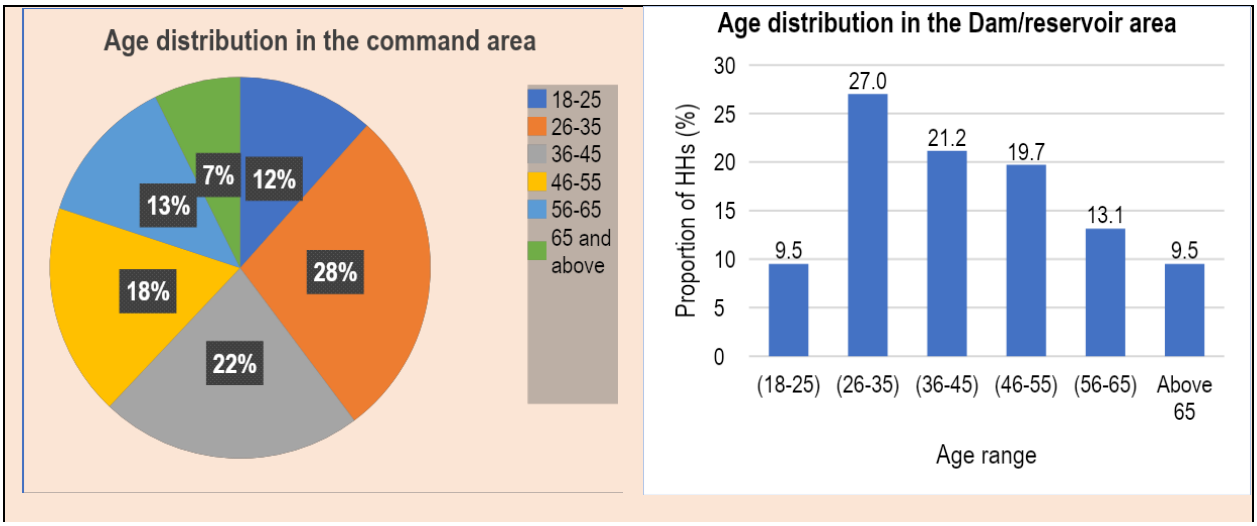


Figure 5-43: Age distribution of household heads in the proposed irrigation scheme command area

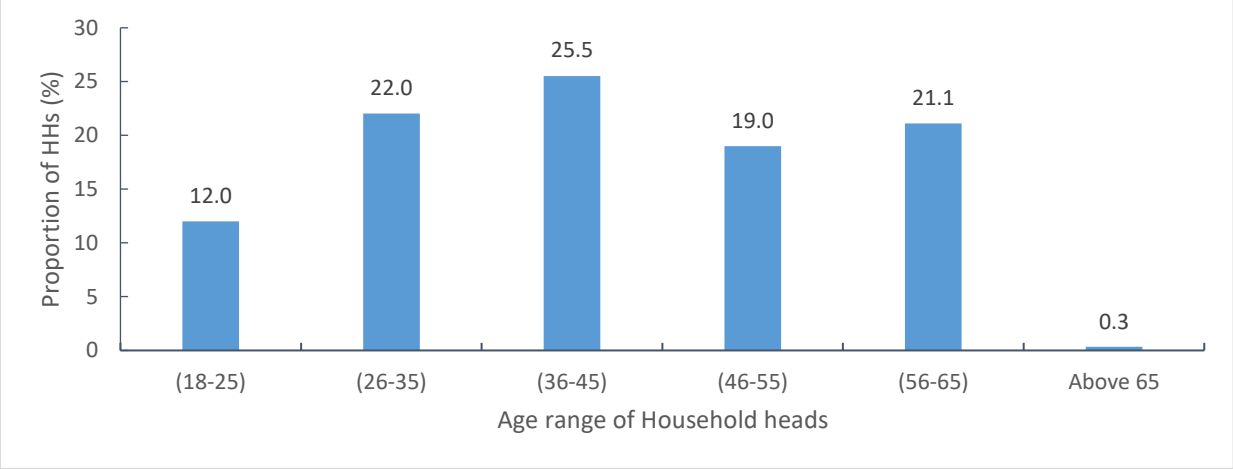


Figure 5-44: Updated household survey of the project area extent.

D. Gender of Household Heads

According to the 2014 population census, 51.9% of the total population in the district were women and 48% were men with population growth rate of 2.1%. Findings of the household survey conducted showed a close range between male and female household heads. Overall, in the command area, majority (56.6%) of the respondents were male whereas 43.4% female respondents. On the other hand, there were more female repeondents (56.6%) in the Dam/reservoir area as comared to their male counter parts (47.4%). Figure 7-3 presents household heads gender distribution by subcounty in the command area.

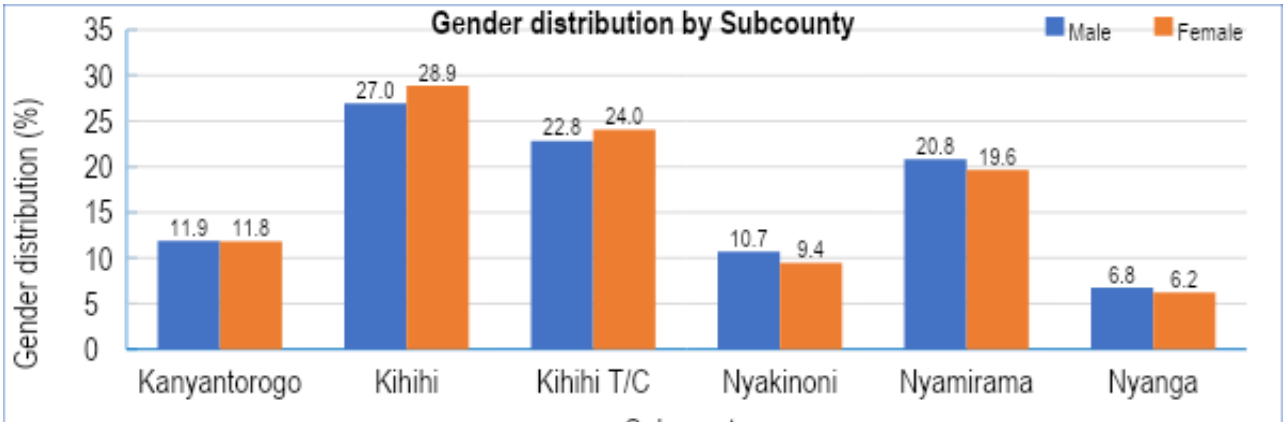


Figure 5-45: Household gender distribution by subcounty

According to the updated findings data of which is from household survey, there was a slight increase in male representative as compared to the earlier study. The survey indicated that majority of household heads were male 54.3% against female standing at 45,7 % as shown in Figure 5-46 below. This could be attributed to the fact that enumerators encouraged household heads to be interviewed and majority happened to be male. Kanungu District development plan 2020/21 – 2024/25 indicated that generally females were more than males, standing at 148,027 females against 140,518 males reflecting true reality of demographic characteristics of Uganda where females are generally more than men.

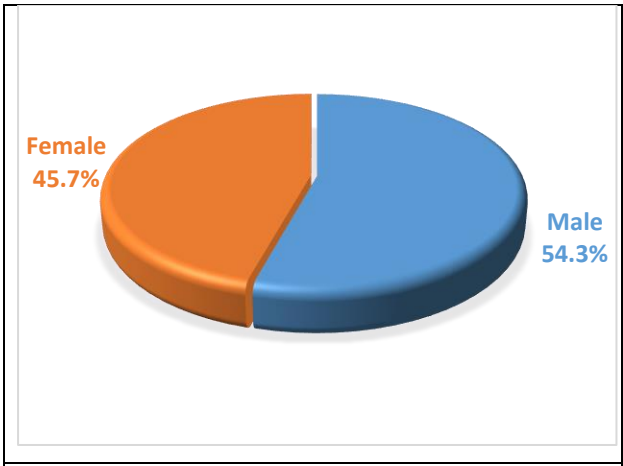


Figure 5-46:: updated gender status in the project area

Figure 5-47:: Male dominated household survey 2023

E. Marital status of household heads

Findings from the updated socio-economic household survey showed that 81.4% of the household heads are married. However, among these some were not officially married sighting challenges in paying bride price as culturally dictated before considering the marriage legitimate. 7.3% of the respondents were widowed, 8.8% single, and 2.3% divorced /separated.

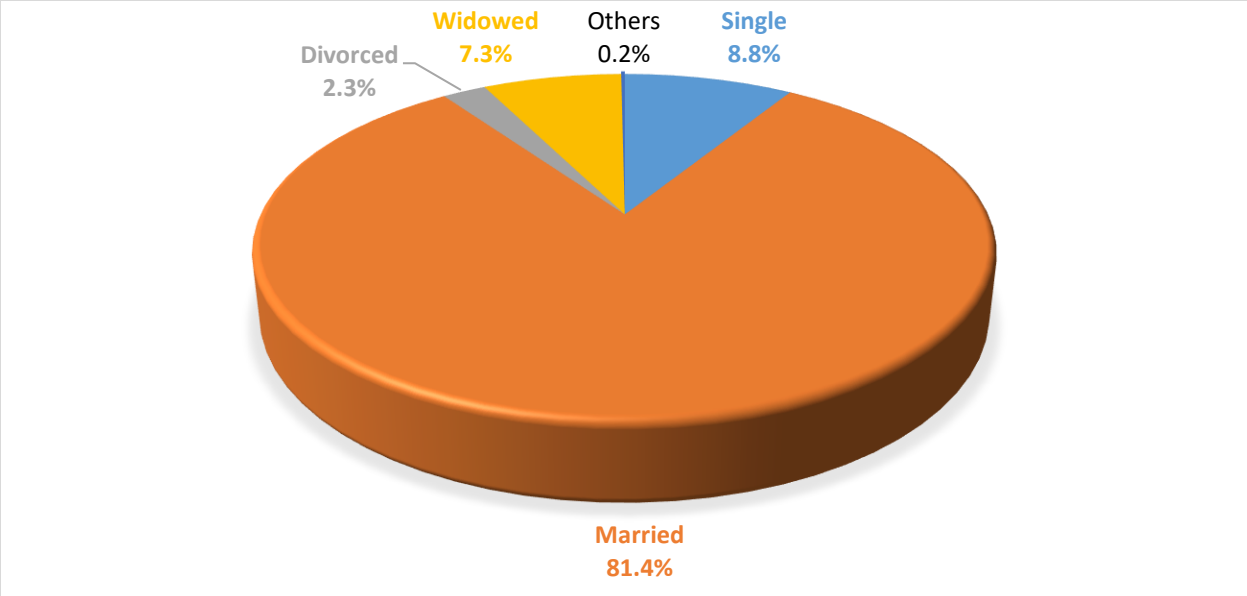


Figure 5-48: Household heads marital status

F. Religion's affiliation

Whereas the religion denomination recorded in both the command area and Dam/reservoir area during the initial survey were dominated by Protestant (58.9%) followed by Catholics (30.8%) and Pentecostals (5.2%), Islam (2.6%) and Seventh-Day Adventist (SDA) (1.9%) as presented in Figure 5-49, there has been a slight during the updated reporting. The protestant remained the dominant religion at 59.0% followed by Catholics at 30.4% Pentecostal at 5.4%.SDA at 2.1% and others including traditional /cultural believers at 0.7% as indicated in Figure 5-50.

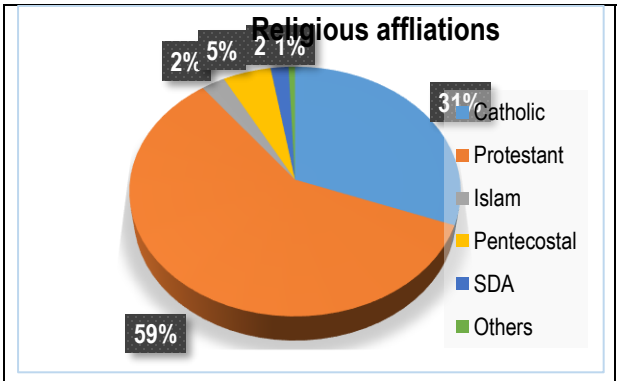


Figure 5-49: Religious denominations in the proposed project area

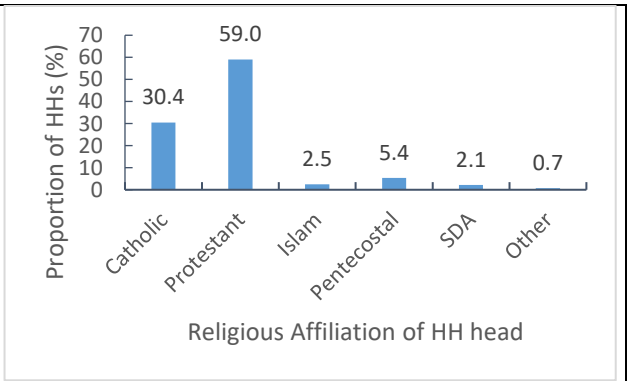


Figure 5-50: Updated Religious denominations in the proposed project area.

There are a number of worshipping centers in the project area. These places gather a number of people and are significant in information dissemination in such communities. These will thus be fundamental in relaying

project information throughout all the phases. Also, days of worship are important to note to enable planning for activities to minimize disruption during such days.

Photo 5-4: St. Peters C.O.U, Nyakinoni

Photo 5-5*:* Kazinga Mosque

Photo 5-6*:* Rushoroza Church

Photo 5-7*:* Kazinga C.O. U

G. Ethnic composition

The project area is heterogeneous, and a number of tribes were established to exist in the area. Findings of the updated household survey showed that majority (85.3%) of the people in the project area are Bakiga. Other tribes such as Bahororo, Banyankore, Banyabutumbi and Batwa also exist. The main language spoken in the area is Rukiga, but Runyankole is also commonly used. This implies that project personal shall embrace the common languages used in the project area for ease of implementation. It is important that local persons are recruited to ease the language concern.

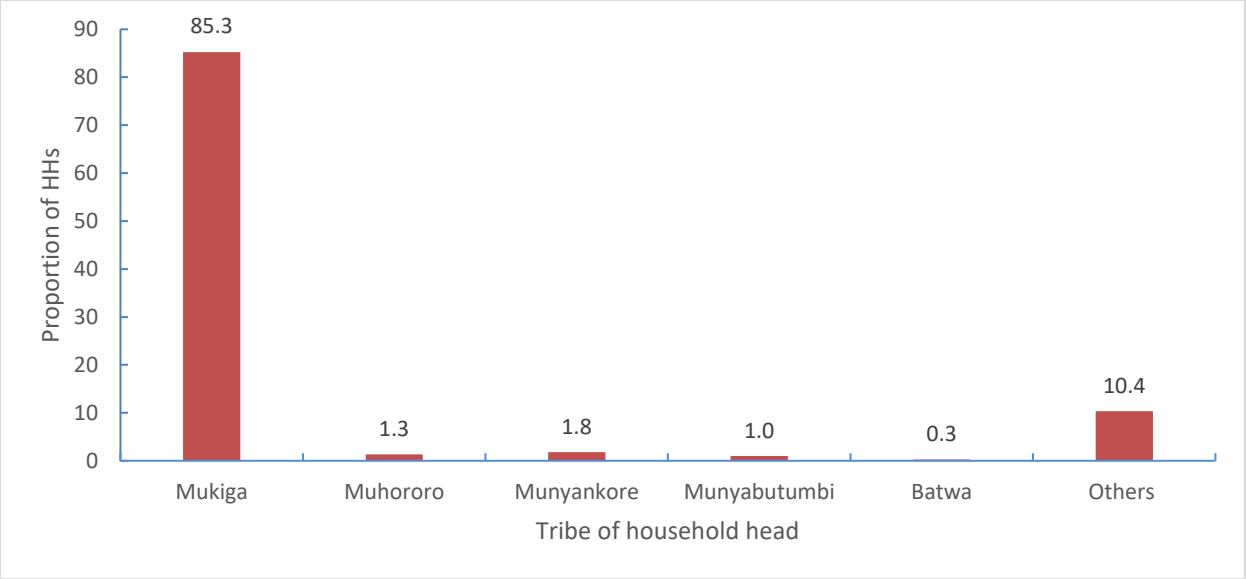


Figure 5-51: Ethnic composition within the project area.

5.6.3 Education and Literacy Levels

Educational attainment is an important indicator of the society's stock of human capital and level of socioeconomic development and refers to the highest level of education that an individual has completed. Generally, there is low completion rate in the district and according to records obtained from the planning unit and highlighted in the development plan indicated negative attitudes towards education has as one of the main reasons for low completion rates in Kanungu.

In Kanungu District, the illiteracy rate among women is lower than that of men. The proportion of persons with education is also higher among women (10.9%) than among men (7.3%). The educational situation of women has improved substantially during the past two decades, at a rate faster than that for men due to the current affirmative action of the promotion of girl child education (Kanungu DDP 2015/216-2019/20).

According to the 2014 NHPC, of the population aged 15 years and above in Kanungu District, 14.8% have never been to school, 58.4% have only achieved primary school completion and 26.7% have achieved secondary education and above. Additionally, 72.03% of those aged 18 years and above are literate whereas 27.97% are illiterate.

In order for the project to bring all stakeholders on board irrespective of literacy levels, stakeholder engagement technical assistance has been secured to identify stakeholder needs, gaps and interests for the project to increase participation in the production and marketing chain. Further support will be provided by the project through extension services and agribusiness technical assistance to ensure success at all levels of farmers to access irrigation services and benefit from the production and marketing chain.

Table 5-30: Education characteristics of Kanungu District

Subcounty	Current Schooling status (6-12 years)		Highest grade completed (15+ years)				Literacy status (18 + years)	
	Attending School	Not attending	Never been to School	Primary	Secondary and above	Total	Literate	Not Literate
Butogota Town Council	1,833	248	918	2,914	1,783	5,615	3,607	1,259
Nyanga	4,513	246	1,576	6,892	3,416	11,884	7,722	2,517
Kambuga	1,011	32	384	1,495	1,542	3,421	2,436	512
Kambuga Town Council	2,588	220	950	4,410	2,974	8,334	5,665	1,510
Kanungu Town Council	3,803	234	1,282	5,814	2,873	9,969	6,391	2,258
Kanyantorogo	1,349	1,392	92	521	2,280	963	3,764	2,396
Katete	5,463	764	2,507	8,204	3,321	14,032	8,243	3,951
Kayonza	3,316	534	1,742	5,519	1,939	9,200	5,520	2,498
Kihihi	3,588	183	1,362	5,509	4,111	10,982	7,455	2,003
Kihiihi Town Council	1,649	183	697	2,870	625	4,192	2,362	1,288
Kinaaba	3,467	217	1,276	5,490	2,693	9,459	6,129	2,091
Kirima	2,408	377	1,132	3,680	692	5,504	3,419	1,350
Mpungu	1,700	115	670	2,726	1,362	4,758	2,954	1,152
Nyakinoni	3,653	324	1,570	6,106	2,082	9,758	5,929	2,624
Nyamirama	1,472	112	643	2,267	1,023	3,933	2,508	891
Rugyeyo	4,145	217	1,468	6,851	2,993	11,312	6,263	3,434
Rutenga	2,542	325	1,079	4,702	1,155	6,936	4,003	1,988
District	**48,543**	**4,423**	**19,777**	**77,729**	**35,547**	**133,053**	**83,002**	**32,234**

Source: UBOS 2014

Education Among the refugees in the Project area

According to the District development plan 2020-2025, there are 2 schools (Kameme & Matanda Primary schools) near the transit center which could offer education services. Matanda PS was blown off by wind and

Kameme is a new school which has been grant Aided. The host community enrolment is striking; gross enrolment is 120%. Findings from the recent District head count indicate that the 2 schools lack adequate classrooms, teacher's houses, textbooks, furniture and teachers which prevent both the refugee and host community children from accessing quality education. Besides, the host community experience early & high teenage pregnancies and child marriages. Early marriages and pregnancy lead to girls dropping out of school, unlikely to ever return. Non-formal education pathways such as catch-up classes and accelerated education programs are required for Kanungu District.

The consultant investigated to ascertain education within the project area as measure of understanding the common ways in which communication and sensitization will best be carried out. the largest percentage of respondents in the study had attended school. This is illustrated in the figure below.

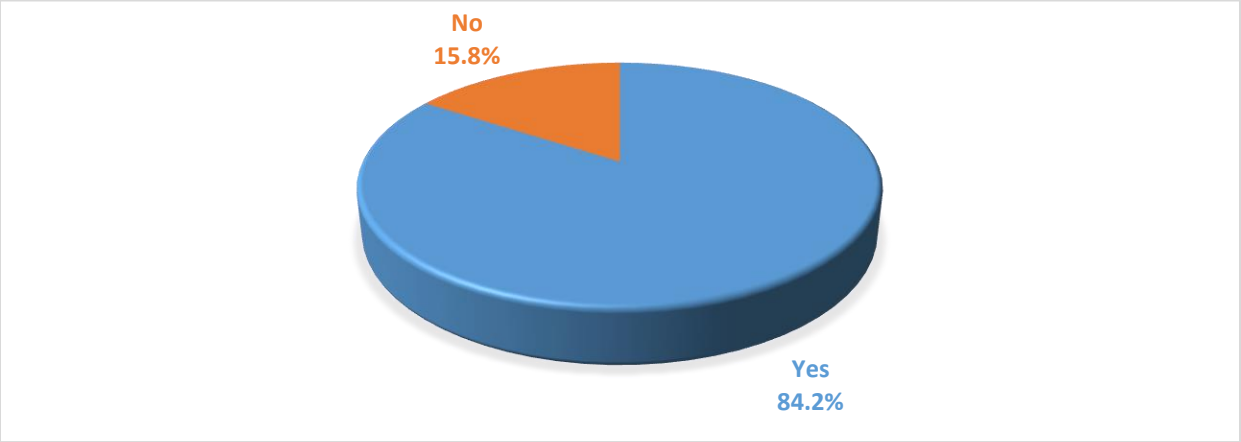


Figure 5-52 Education status amongst the households interviewed in the updated study

Findings of the household survey showed that the highest level of education attained by majority of the household heads is primary education (71.6%), followed by ordinary level (19.1%) and vocational training (3.6%). 2.4% of the household heads have completed advance level whereas 3.1% have completed university. After ordinary level, many of the students join vocational training for such courses; tourism, hair dressing, electrical and mechanical, midwifery and nursing, military and crime prevention, agricultural skills, brick laying, carpentry and joinery, computer knowledge, driving and riding, bakery, tailoring, teaching, plumbing and welding among others.

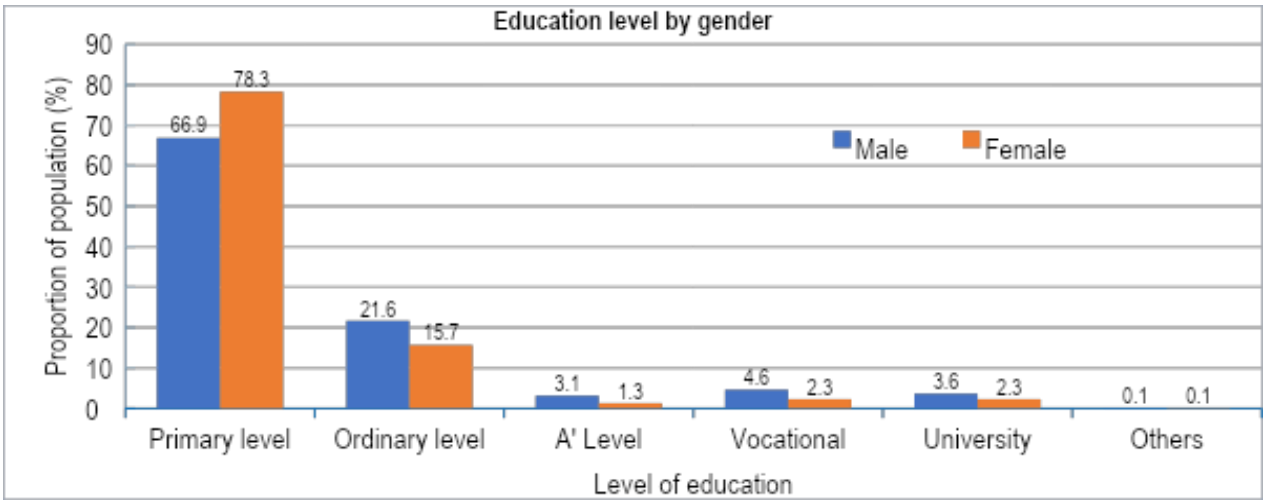


Figure 5-53: Education level by gender

A general outlook of the updated study (2023) did not indicate significate change in the levels of education in the project area. Data collected from the additional villages showed that 72.0% of the respondents had attained primary level of education, 18.9% ordinary level, 2.4% A level followed by 3.7% and 2.9% vocational and university respectively as illustrated in figure below.

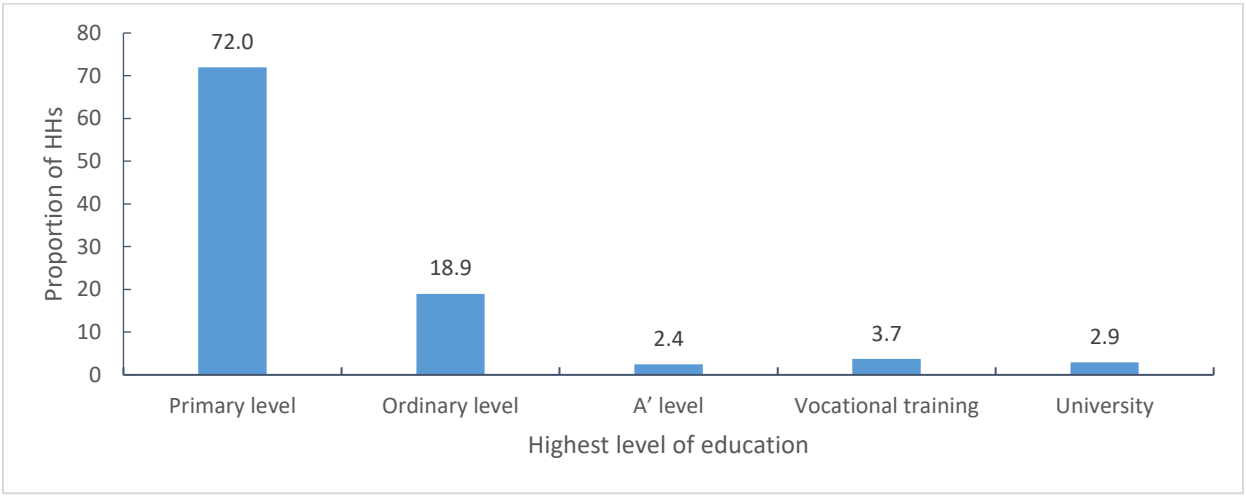


Figure 5-54: Updated level of education in the project area.

A number of school institutions were identified during the first and updated assessment across the project area. This is an indicator that education can be accessed across all the sub counties. Notable schools that have been enumerated in the study are shown in table 7-5 below.

Table 5-31: Some of the education facilities in the command area

SUB COUNTY	PARISH	VILLAGE	NAME OF INSTITUTION	EASTING	NORTHING
Kihiihi	Rusoroza	Kazinga Upper	Zendaire Day And Boarding Pri Sch	798068	9921159

Kihiihi Town Council	Rwanga Ward	Ibambiro	Kashuzwa P/School	799274	9920244
Nyanga	Nyanga	Rutooma	Nyanga Parental Care Nursery Sch	796029	9916880
Kihiihi	Rusoroza	Kibimbiri	Kibimbiri Pri Sch	800660	9924250
Kihiihi Town Council	Kihiihi Town Ward	Ruyayo	Kihiihi Community Polytechical College	800325	9918116
Kihiihi Town Council	Rwanga Ward	Binyungu	Kagambira Foundation School	798463	9918460
Kihiihi	Kabuga	Bushere	Bushere Pri Sch	802808	9922713
Kihiihi	Kabuga	Kayembe	Kayeme Primary School	802128	9921745
Nyanga	Nkunda	Kazinga	Kazinga Pri Sch	795881	9916486
Kihiihi	Kibimbi	Rusoroza	Ermino High Sch	803619	9923756
Kihiihi	Kabuga	Kayembe	Kayeme Nursery School	802128	9921745
Nyanga	Nyanga	Rutooma	Nyanga Parental Care Pri Sch	796029	9916880
Kihiihi	Kibimbi	Rusoroza	Rusoroza Pri Sch	803772	9923674
Kihiihi	Kibimbi	Matanda	Matanda Pri Sch	805573	9923819
Kihiihi	Rusoroza	Kazinga Upper	Kororo Pri Sch	797803	9922573

Table 5-32: Some of the education facilities in the Dam/reservoir area

Subcounty	Parish	Village	Institution name	Easting	Northing
Kirima	Kihanda	Bujerengye	Kihanda Standard Academy	805745	9906707
	Kihanda	Rurama	Kihanda Technical School	805693	9907438
	Kihanda	Nyakibuga	Kihanda Cou Pr School	805663	9907596
	Rutugunda	Kitongo	Kitongo Pr School	807331	9906474
Kanyantorogo	Burema	Kashanda	Kanyantorogo Top Hill P/Sch	801684	9908407
	Kishenyi	Kishayo	Kishayo P/Sch	801230	9910251
	Burema	Kitookye	Infant Nursery And P/Sch	801201	9909812
	Burema	Kashanda	Kanyantorogo Community P/Sch	801311	9908541
	Burema	Kahama	Burema P/Sch	803239	9907102
	Burema	Kashanda	Kanyantorogo Sss	801477	9908644
	Burema	Kahama	Burema Sss	803088	9907370
Katete	Nyakishojwa	Nyakishojwa	Katete Great Lakes High School	806044	9911371

On gender basis, findings of the household survey showed that generally, men's levels of education are higher than those of their female counterparts except for the category whose highest level of education attained primary level. This could be attributed to factors like early marriages of the girl child after primary school and lack of funds by the parents to advance their girl child after primary school. Traditional brief that educating a girl child is not as important as educating a boy child is still prevalent among some households.

Photo 5-8 Kigarama primary school in Nyamirama


Photo 5-9: Kihihi NAVNEET lovely day care

5.6.4 Land Use and Tenure System

Land Use

According to Kanungu DDP 2020/21 – 2024/25, agriculture is the main land use in Kanungu District and a major Economic activity. The land is highly fragmented due to traditional practices of inheritance and high population density. The concept of ‘’land use planning‟ is still new and is only practiced to a limited extent in the townships, where specific areas are assigned for industries, commercial building, residential, road networks and institutional sites. Parts of the district lie in Queen Elizabeth National Park (QENP) biosphere reserve and Bwindi Impenetrable National Park (BINP) World Heritage Site.

Subsistence agriculture is the major economic activity in the district employing 81% of the district labour force. This is characterized by use of poor methods of farming and low levels of production and productivity. Major crops grown include maize, bananas, beans, coffee, ground nuts and cassava. Major livestock kept include pigs, poultry, goats, cattle, and sheep.

Cultivation covers most hilltops and many wetlands have been drained, while very little of the original forest outside the parks still remains. Land shortage, coupled with intensive use for subsistence agriculture, has led to soil degradation, poor yields and ultimately poverty. Some small-scale artisan fishing takes place within inland water bodies including wetlands and rivers (Kanungu DDP 2020/21 – 2024/25).

Findings of the household survey also affirmed that the main land use in the project area is agriculture and mainly crop farming; however, other use depends on ownership, tenure, and customs. Consultations with communities revealed that the land is used mostly for crop farming, livestock growing, residential dwelling and trading business activities as indicated in Figure 5-55 and Figure 5-56: See Appendix J for elaborate agro-

economical description. The changes to land in the updated survey did not change significantly as 83.2% of respondents indicated crop farming as their predominant land use in the project are as indicated in figure below.

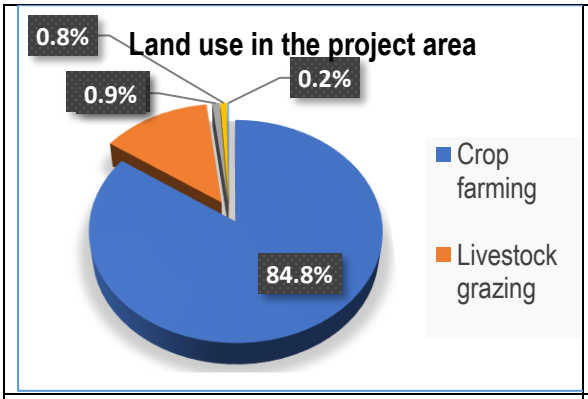


Figure 5-55: Land use in the proposed project area

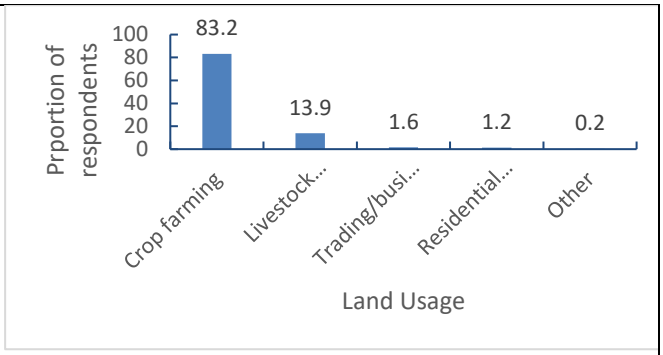


Figure 5-56:updated land use 2023

The consultant also investigated the land cover distribution in the project area and according to the district natural resources office Kanungu is covered by several land covers as highlighted in Table 5-33.

Table 5-33 Land cover distribution in the Kiruruma watershed

Land cover/Use	Acreage (Sq. km) (ESIA study)	Area covered (km^2) (Detailed Design)	Coverage (%) of total area
Closed Bush land	11.5	15.8	9.2%
Closed Grassland	9.2	8.3	4.9%
Dense Natural Forest	2.1	2.2	1.3%
Moderate Natural Forest	1.3	1.3	0.7%
Open Bush land	24.6	24.7	14.4%
Open Grassland	1.7	2.0	1.2%
Settlement	0.6	0.7	0.4%
Subsistence Cropland	108.3	116.0	67.9%
Wetland	0.0	0.001	0.001%

Land tenure and Ownership

There are four types of tenure recognised in Uganda under the Constitution (Article 246) and the Land Act (Cap 227): customary tenure, freehold, leasehold and Kibanja. Of these four, the project area is characterised by three land tenure systems: customary, leasehold and freehold. Much of the land is held in customary private ownership although there are few relatively well-off farmers with leasehold titles. Grazing lands are communally owned and land fragmentation is a common feature (Kanungu DDP 2020/21 – 2024/25). The socio-economic survey indicated that most of the land (64.6%) in the project area is customary.

The customary ownership and informality challenges with respect to land is being addressed in the RAP and other management plans as follows;

1. Mapping individual household land parcels. The project will undertake land boundary mapping with full participation of owners and local government units to identify land size and boundaries of each household and have it recorded in the strip map for future reference to mitigate conflict.
2. During preparation of the RAP, all PAPs are identified through surveys and their land among other assets is mapped and captured in the asset inventory. The project thereafter enters into compensation agreements with the PAPs by recognizing the affected portion and guaranteeing the secutity of the remaining portion.

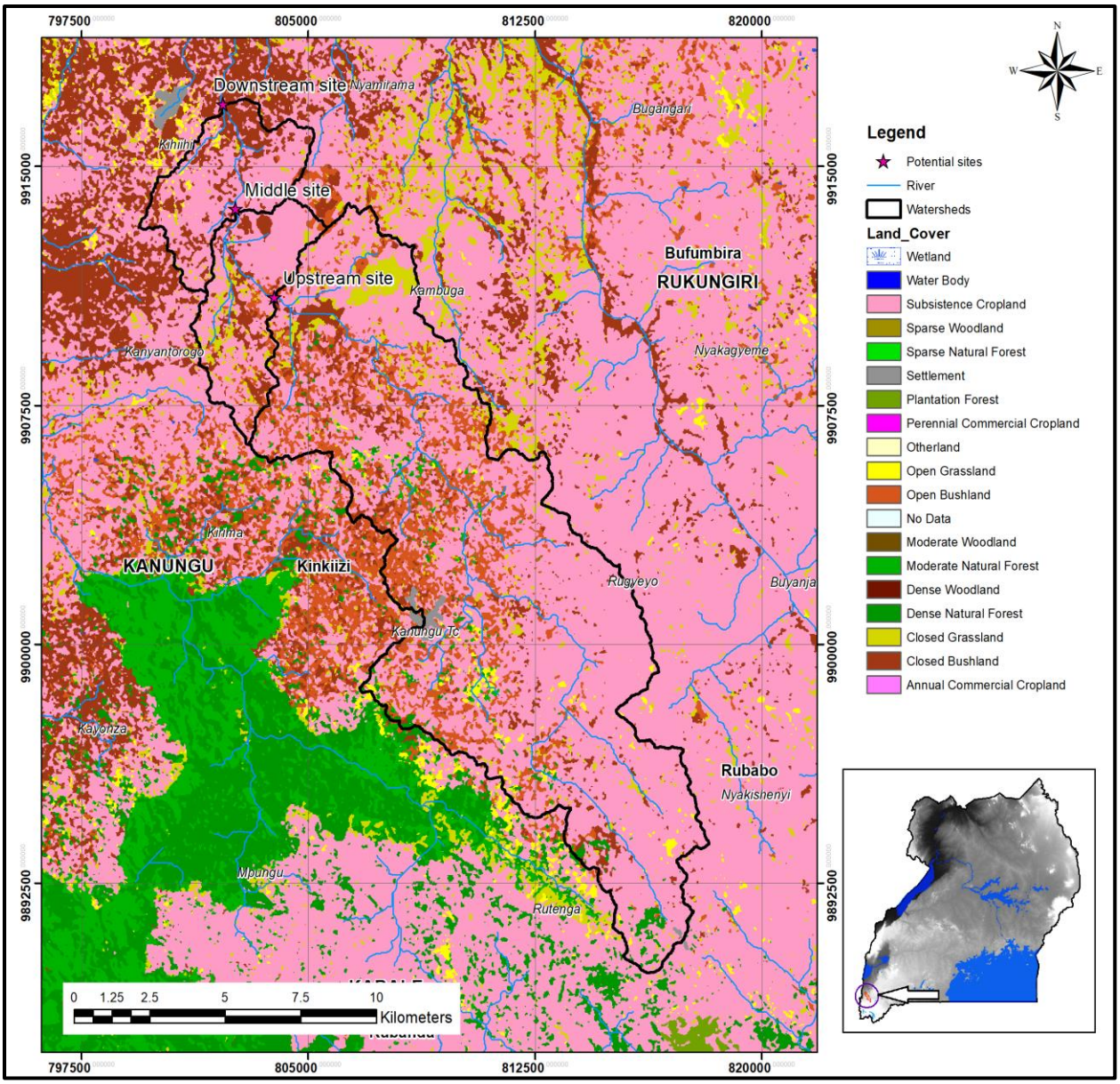


Figure 5-57: Area Land use and land cover (LULC) in 2014

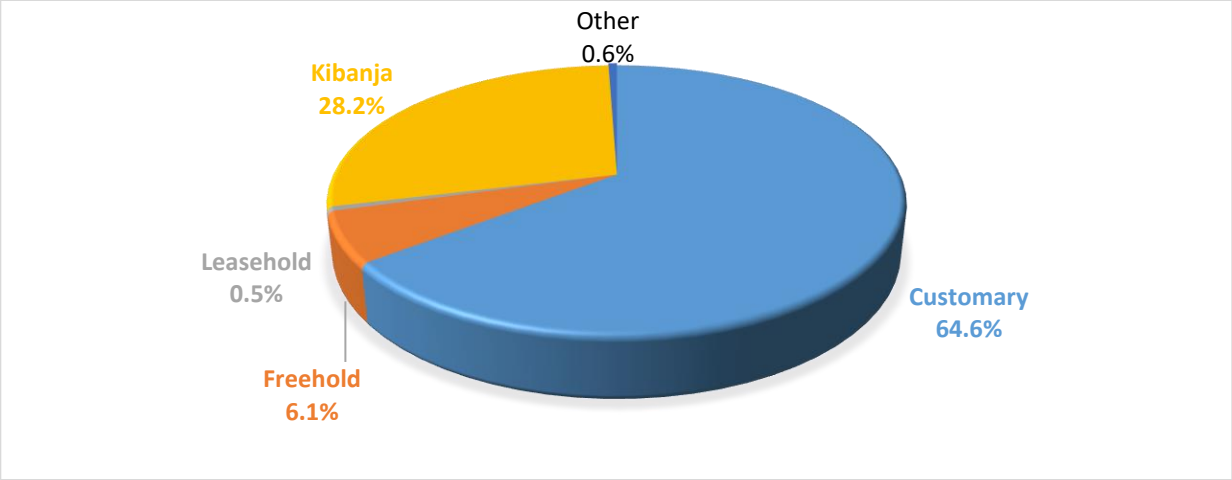


Figure 5-58:Land tenure systems in the project area

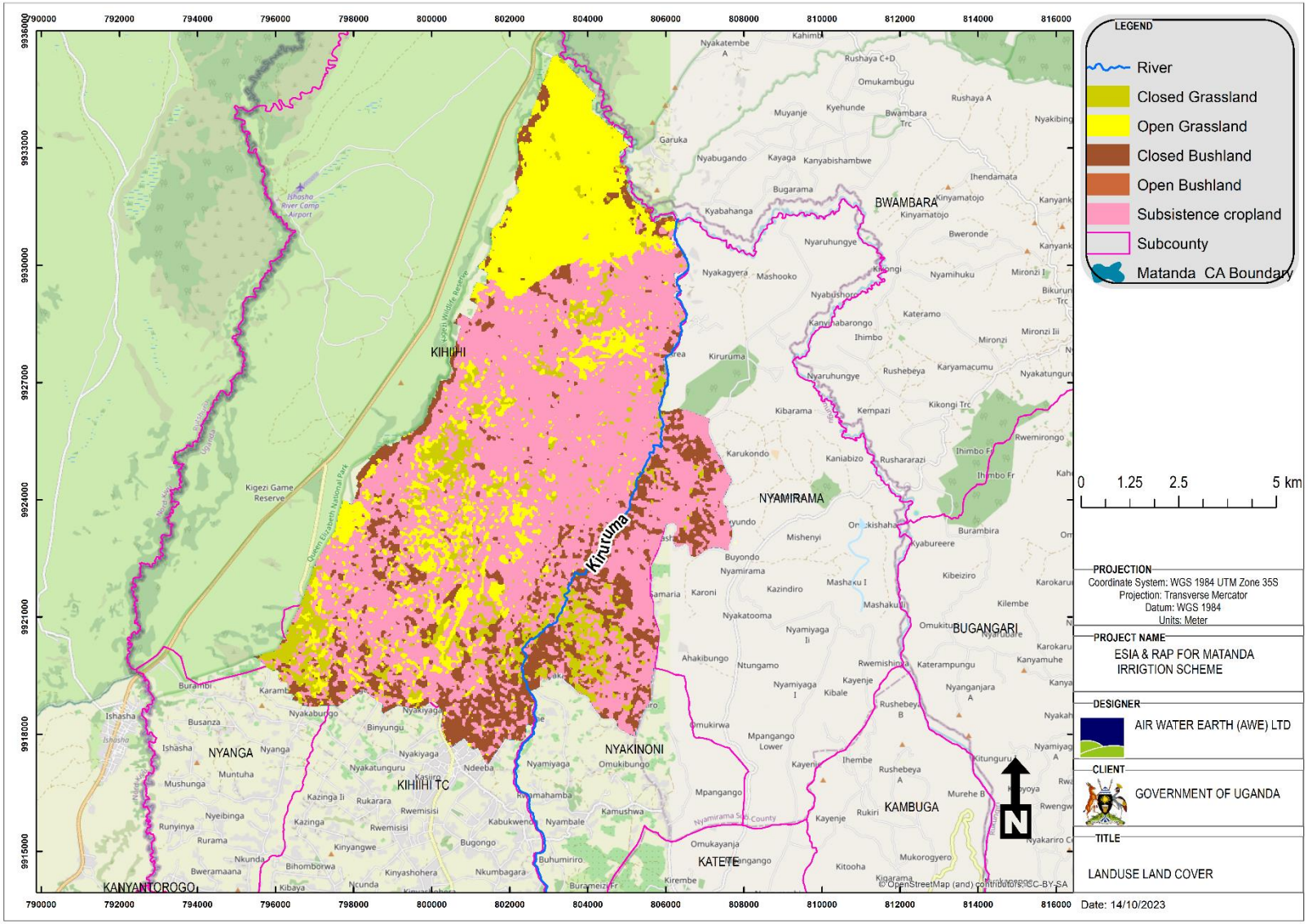


Figure:5-59: Land-use cover in the proposed Matanda irrigation scheme command area

Access to land

Land in the project area is accessed through a number of ways which include;

- Purchase: This is mainly done on unregistered land since most of it is unregistered customary tenure. As such, sales agreements from this type of transaction are usually not properly documented or formalized and can be contested by other people claiming they have a claim over the land.
- Inheritance; It is common in the Project area for people to acquire land through inheritance of family assets passed on to generations from families or clans.
- Rental and lease; These are common in the central part of the district and informal oral agreements between land owners and land users are common. Informal land rental is common as households rent fertile land parcels for agriculture. Project developers in the area also acquire land for short term use for temporary construction auxiliary facilities e.g., workers' camps.
- Marriage; this is another way of accessing land in the project area especially for men who are granted parcels of land by their parents upon marriage. Women can also obtain access to land from their husbands upon marriage although these rights are often limited and reversible.

Figure5-60: typical land area divided up by the family head amongst his children in Kihihi subcounty

5.6.5 Livelihood Strategies

In 2014, close to 80% of all households in the country were involved in agriculture compared to 74% in 2002. Of the households involved in agriculture, nearly 75% were engaged in crop growing while 58% were involved in livestock keeping (UBOS 2014). According to Kanungu District Five Year Local Government Development Plan 2020/21 – 2024/25, Subsistence agriculture is the major economic activity in the district employing 81% of the district labour force. This is characterized by use of poor methods of farming and low levels of production and productivity. Major crops grown include maize, bananas, beans, coffee, ground nuts and cassava. Major livestock kept include pigs, poultry, goats, cattle, and sheep. Key performance agricultural Indictors are highlighted below in Table 5-34.

Table 5-34: District Agricultural growth indictors

Performance Indicator	District Baseline (FY2014/15)	Current Status (FY2019 / 2020)
The increased number of households and cooperatives in using coffee drying tables	0	3 farmer cooperatives
Increase in number of farmers/ HHs benefiting. from irrigation	0	3 irrigation schemes
Increased number of model farmers	12	73 farmers
Increase in processing plants	1 tea factory	3 tea factories, 8 rice hullers, 30 coffee hullers, 2 winery & 1 honey
Increase in milk coolers of 300 liters capacity	1	3 coolers
Farmers using tractors	12	40
Farmers using irrigation	0	14
Fishponds stocked	12	75
Farmers in commercial farming	12,00	39,642
Farmer extension ratio reduction	3200:1	1134:1
Extension staff		43 staff

Updated household survey results indicate that agriculture is the main economic activity in the district (89.0%) followed by salaries (1.8%). Other activities include trade (1.5%), among others as indicated in table below Table 5-35.

Table 5-35: Household livelihood sources

Main source of income for the household	**Freq.**	**Percentage**
Agriculture, crop	1828	89.0

Main source of income for the household	Freq.	Percentage
Agriculture, Livestock	7	0.3
Carpentry	3	0.1
Construction	18	0.9
Trade	30	1.5
Transportation	11	0.5
Salary/Wage	37	1.8
Others	8	0.4

a) Crop farming

Crop farming is carried out in all the Sub counties within the command area. Farming in the project area is mainly subsistence and majority of the farmers practice mixed farming. The major food crops grown include maize (49.8%), followed by beans (22.2%) and millet (13.5%), other crops grown on small scale are Rice, millet and Irish potatoes. Cash crops are also grown in the command area; coffee being the predominant crop. A few households grow cotton and tobacco. The tea grown within the command area is purchased and processed by Kayonza Tea Factory and Kigezi Development Tea Factories located in Butogota Town Council and in Rugyeyo Subcounty respectively. See Appendix J for elaborate agro-economical description.

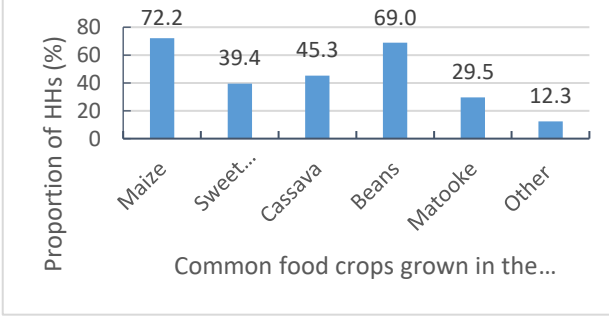


Figure5-61: Common food crops grown in the command area

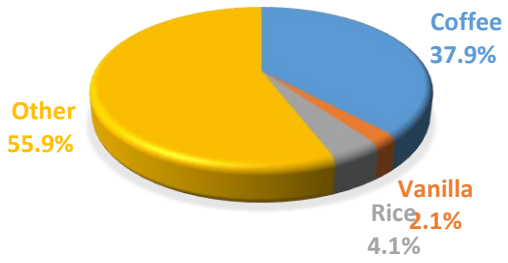


Figure 5-62: Common cash crops grown in the command area as updated

Figure 5-63 intercropped cash crop gardens observed within the project area.

Similarly, in the dam/reservoir area, the major food crops grown by household heads include beans (84.1%), bananas (70.5%), maize (65.9%) and cassava (62.1%) among others, as indicated in the figure below. Coffee is the only cash crop grown in the area and this includes both Arabic and Robusta.

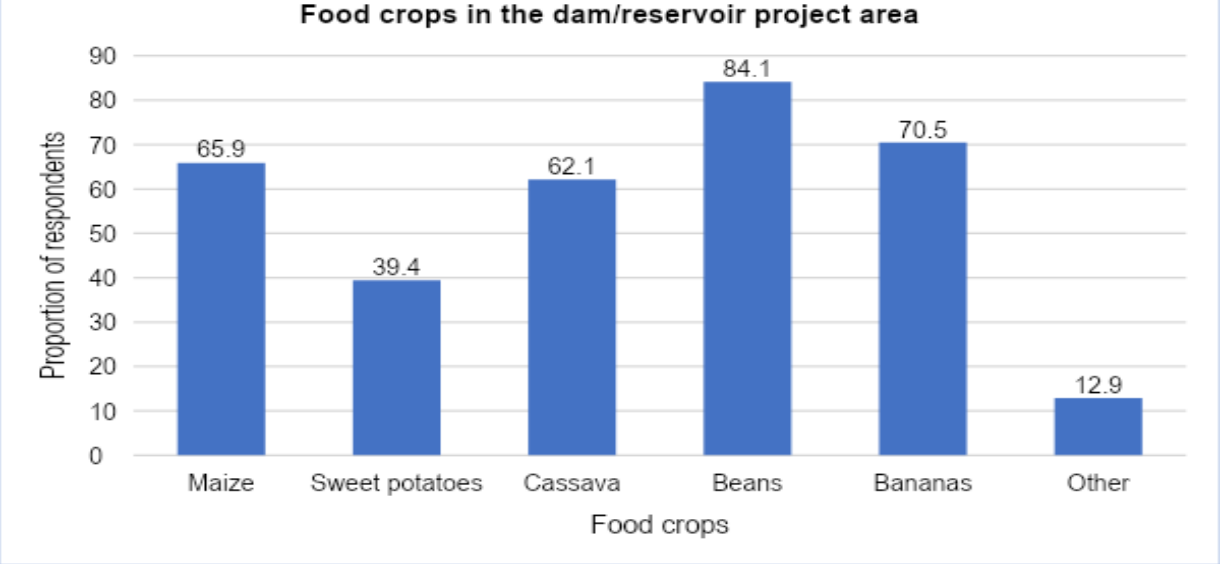


Figure 5-64: Major food crops grown in the dam/reservoir project area

Photo 5-10 Millet growing in Rushaka

Photo 5-11: Rice growing in Kyentuhe

Photo 5-12: Banana plantation in Nyabirehe village

Photo 5-13 Sorghum growing in Kanyantorogo

Photo 5-14: Maize growing in Nyamirama

Photo 5-15: Coffee growing in Nyamirama

Photo 5-16: Mixed farming (Maize and beans)

Photo 5-17: Tomato growing in Kihihi

Production Practices

i. Agricultural Inputs and tools for farmers

Farmers in the project area mainly use hand hoes to plough their gardens, axes and pangas to clear the land. Those that can afford also hire tractors although this is limited to only a few households because of the high rental costs involved. In the planting period, most of the farmers use recycled seeds that were spared from the previous season as they can all not afford to buy seeds at the beginning of every planting season. Local communities usually rely on abundant seasonal rainfalls to provide water inputs to their crops.

Photo 5-18: Major Production tool commonly used within the project area.

Findings of the household survey conducted indicated that 60.6% of the households involved in farming use fertilizers and agricultural burning to boost output whereas 39.4% are not dependent on fertilizers. Artificial fertilizers such as NPK and Urea are mainly used in Cereals and vegetables; Organic manure/compost is mainly used in Banana and coffee plantations whereas in some Sub counties such as Kihihi and Kanyantorogo, some farmers also use Bio slurry made from cow dung.

ii. Size of cultivation areas

A Key Informant Interview (KII) with the agriculture officer of Kihihi Town Council and Katete subcounty informed that in the command area and dam/reservoir areas respectively, a household is generally regarded as rich if it owns more than 10 acres of land; the size of the land cultivated therefore is an essential element to social status and perceived wealth of a household. In the project areas, the average size of cultivated land per household ranges from one to five acres, while a few individuals especially businessmen own larger plots of land that range between 10 to 100 acres. Some households also own more than one plot in different villages. In the updated survey, the community members informed the consultants that the size of land owned by an individual within the project area keeps on decreasing due to fragmentation commonly used in Kanungu district.

iii. Farm management

An FGD with farmers in Nyamirama revealed that farmers use various techniques to maintain soil fertility and improve productivity of their land, these include;

- Inter-cropping: where several types of crops are planted on the same parcel at the same time;
- Mulching: where farmers leave crop stems and residues to rot in the garden after harvest;
- Crop rotation: where farmers change the type of crop grown on one piece of land between two planting seasons; and
- Fallow: where land fallow is left between different crop production periods.

Photo 5-19: Intercropped garden as a measure of ensuring fertility and water in the soils in Kakinga village.

iv. Marketing of Crop Farming Products

Findings of the socio-economic survey (key informant discussions and focus group discussion) revealed that majority of the farmers sell their agricultural produce locally in markets. The major market in the command area is Kihihi Town Council market that is open to the public every Saturday. This market attracts traders and farmers from all the Sub counties in the command area and deals in all commodities including livestock, farm produce and clothing among others.

Other Sub counties also have weekly markets e.g., Nyamirama market that opens every Friday and Katete weekly market that takes place every Thursday. Besides the weekly markets, some farm products are sold on the roadside on a daily basis either to neighbors in the village or to middlemen from within and districts. Trading centers are also open for daily sale of agricultural produce. Findings of the household survey revealed that majority of the respondents have to mover over 5 km to access a market to sell their produce.

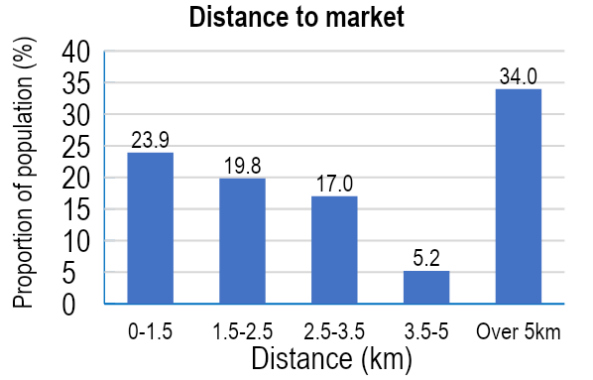


Figure5-65: Estimated distance to markets

Photo 5-20: A trader transporting Bananas to the market in Kihihi

For cash crops like coffee, vanilla and maize, various middlemen have established buying centers across the project area and many fathers exploit these avenues for marketing of their crops. According to the focus group discussion held with fathers during the updated study, bananas are outsourced directly from the farmers to Kampala. Indeed, during transect drive within the project area, many tracks would be seen carrying bananas from the deep villages of Kanungu District including Matanda.

Photo 5-21:Focus group discussion with farmers in Kihihi during the updated study.

Photo 5-22:Common transport means for bananas in the project area.

Challenges in Crop Farming

i. Pests and Diseases

FGDs revealed that pests have continuously threatened farming in the command area. Various crops are attacked by different pests in different ways; some of them cause direct injury to plants by eating leaves and burrowing holes in stems, fruit and/or roots whereas others cause indirect damage, where the insects themselves do little or no harm, but transmit bacterial, viral or fungal infection to a crop, as discussed below;

- Coffee: among all crops grown in the command area, this is the most affected crop. The Twig borer is the most destructive pest to coffee in the area. It affects coffee at a young stage; “eating” branches

when they are still tender. Coffee berry borer attacks the fruits or berries. Other least destructive pests include the Mill burg which feeds on all parts of the coffee plant, especially the leaves.

- Cereals and vegetables; the common pest is the Cat worm which attacks immediately after germination and feeds on the leaves. Aphids also attacked before and during the flowering phase. Vermin including rats and squirrels attack cereals e.g., ground nuts, beans and rice even after harvesting.
- Birds that feed on rice, beans and maize, destroying the leaves especially of the climbing beans.

In Katete subcounty (dam/reservoir area), consultations with farmers reaveled that the major pests and diseases in the area include banana wilt, coffee wilt and coffee rust, beans and maize weevils, tomato bright, and cassava mosaic.

ii. Lack of good marketing skills among farmers and businesspeople

Most of the farmers' groups or cooperatives usually do not have marketing skill. They are managed by someone from the members of a group who do not have any knowledge on marketing and managing business as such. Groups or cooperatives will have to use marketing strategy to run their business. Some of the innovative strategies followed are: fair price shop, branding etc. there is need for Government to support farmers' groups in providing services and finance as a seed capital to start their business.

iii. Inadequate physical infrastructure e.g. road network

Poor infrastructure, especially the poor road network, considering the hilly nature of some parts of the project area especially Kanyantorogo, make it hard for the farmers to transport their produce from their farms to the markets.

iv. Climate change

This has resulted into numerous problems including changes in rainfall patterns, increased frequency, unprecedented intermittent flooding, and intensity of droughts among others which compromise the productivity of farmlands especially for areas that entirely depend on rain to water their crops.

b) Livestock

According to Kanungu District Five Year Local Government Development Plan II 2015/16 – 2019/20, many people in the district keep livestock on a subsistence level, primarily for milk production. Milk is part of the local diet and is a requirement for almost every household. During the field visits it was established that some households reared livestock such as goats, cattle, sheep, chicken and a few cattle and watered them along the river. However, few people kept cattle in large numbers since they are traditionally agriculturalists. The local economy benefits from the sale of livestock and livestock products such as meat, milk, skins and hides. Milk is the main cattle product, but live animals and meat are also sold at local and national markets.

During the household survey, 86.2% of the respondents mentioned that they rear livestock. Majority of households in both the command area (52.1%) and the dam/reservoir area (34.3%) are involved in poultry keeping. Findings also indicated that a significant number of respondents rear cattle (23.5% in command area and 10.5%)), pigs (11.2% in the command area and 24.4% in the dam/reservoir area) and goats (5.6% in the command area and 29.1% in the dam/reservoir area). Other livestock reared include ducks and sheep among others (*Figure5-66*).

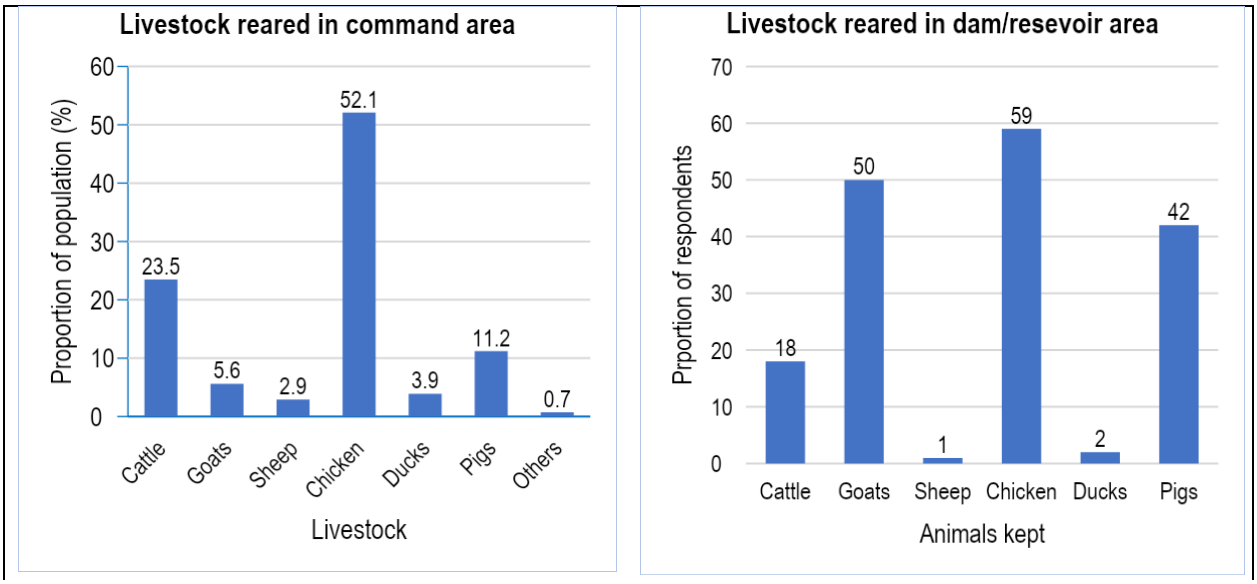


Figure5-66:: Livestock rearing in the project area.

Grazing in the project area is mainly free range; where animals, under the supervision of a herdsman, roam freely, usually practiced in communal grazing areas; and tethering system where animals are tied to a tree or stake close to homesteads.

Photo 5-23: Cattle grazing in Nyakinoni

Photo 5-24: Goat rearing in Karubeizi

Challenges in livestock rearing include:

i. Drought that leaves the animals with no pastures
ii. Limited land for grazing
iii. Low milk productivity of local cattle

iv. Limited processing and storage facilities
v. Diseases e.g., African Animal Trypanosomiasis, Fowl pox and Newcastle diseases

In order to improve livestock production, the project will provide water hydrants for individual connections at household level within the scheme and communal level.

5.6.6 Income levels

The consultant investigated income levels in the project area as a measure to understand resilience of households but also check on weather household can afford implements once irrigation kick starts within their communities. Household earnings include income from subsistence farming, commercial farming, wage employment, income from non-agricultural enterprises, property incomes, transfers, remittances, and organizational support among others. According to household survey results, the major source of income amongst the communities within the project area was agriculture (crops) contributing 89.0% followed by salaried and trade 1.8 and 1.5% respectively as indicated in figure below (Figure5-67).

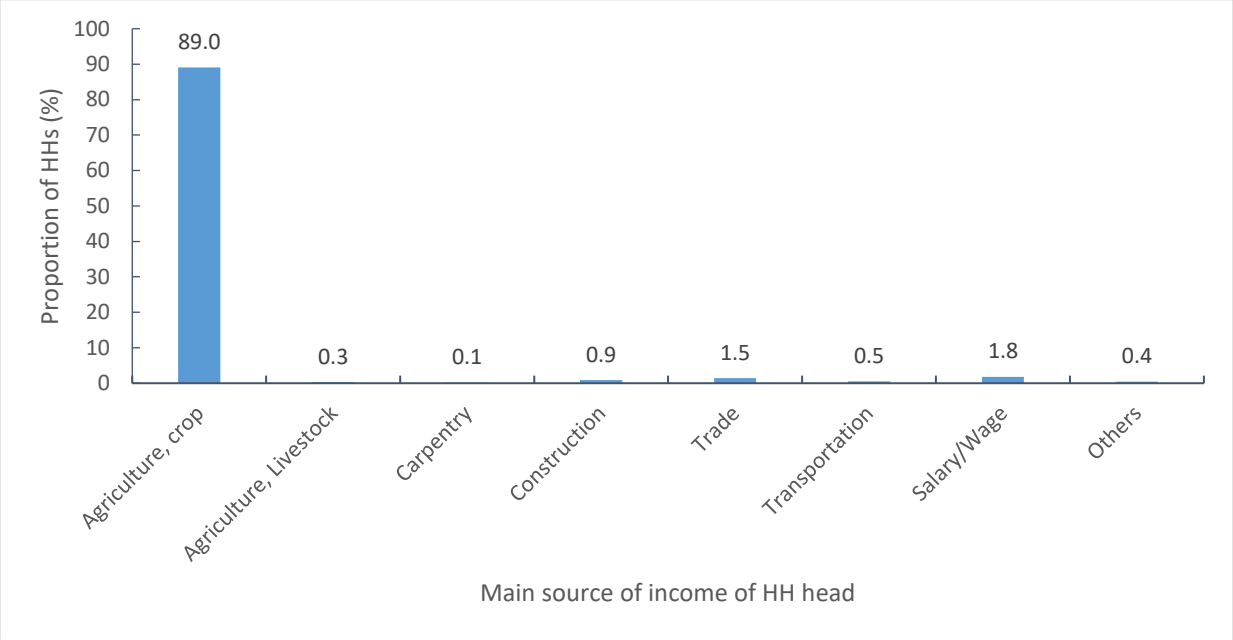


Figure5-67: income sources within the project area

Findings of the updated socioeconomic survey revealed that majority (32.8%) of the respondent households earn 100,000Ush and below monthly. As shown in Figure5-67, 18.8% earn between 100,000 to 200,000, 11.9% earn between 200,000 – 300,000Ush. Only about 19.3 % of the respondents earned above 500,000 of the projects.

Table 5-36:average monthly income levels within the project area.

Average household Income	Freq.	Percentage
0-100,000	673	32.8
100,000-200,000	386	18.8
200,000-300,000	244	11.9
300,000-400,000	143	7.0
400,000-500,000	160	7.8
Above 500,000	397	19.3

5.6.7 Expenditure patterns

Regarding expenditure patterns, the results of the survey indicated that for majority of the households much of their income is spent on investing in agriculture e.g buying farm inputs like seeds (26.5%) and on educating their family members (Education). Medical expenses and household assets also consume part of their monthly income (Table 5-37).

Table 5-37: Household monthly expenditure

Expenditure	Freq	Percentage
Investing in agriculture (seeds, land rent, tillage etc)	534	26.0
Investing in other business (shop, production etc)	93	4.5
Household assets (phone, TV, motorbike, etc)	227	11.1
Education	535	26.1
Food	397	19.3
Medical expenses	225	11.0
Others	1	0.0

5.6.8 Household assets

Asset ownership is one of the indicators for welfare measurement. In this study, the ownership referred to is by any usual member of the household and is presumed to mean that all members can access the asset. As shown in Figure 5-68, households in the project area own various assets including Radios, houses, land, TVs and Bicycles among others.

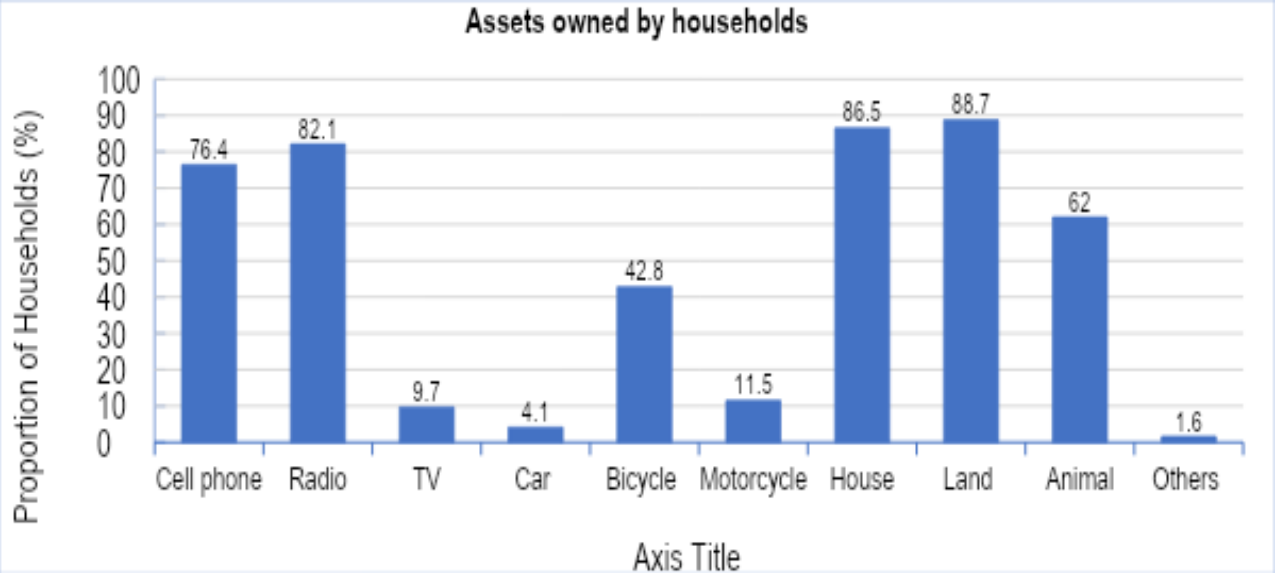


Figure 5-68:Assets Owned by Households in the Project Area

5.6.9 Mineral Resources

There are prospects of oil and gas products mainly in the sub-counties of Kihihi and Nyanga. Commercial iron ore deposits are found in Kyeshero Parish- Kayonza Sub County. There are other prospects of wolfram and gold mainly in Kanungu Town Council and Mpungu Sub County. The excavation of sand and clay takes place mainly in Nyakinoni Sub County and Kambuga TC for construction and pottery purposes. Existence of various minerals such tantalite reserves in Burema parish in Kanyatorogoand Kihanda in Kirima. Gold especially in Kanungu Town council, Kayonza Sub County and Mpungu sub-county.

According to the district development 2020-2025, there is some low mining in the district: Mining and quarrying employs only 0.12% of the district labour force. Clay, sand and rock outcrops are the common minerals that are currently taking place in the district. However, there are iron ore deposits in Kayonza that needs to be exploited and oil and gas deposits in Kihihi and Nyamirama that greatly require.

5.6.10 Energy

According to the district development 2020-2025 reviewed in the updated report the energy situation in the district is that more than 95% of the population use biomass as their primary energy source for cooking, lighting and warming. For the rural communities, the use of firewood is almost 100%. The situation is worsened by the rudimental methods which are wasteful and also a health hazard considering the carbon emissions. As a result, the district has put up management measures and strategies to ensure reduction in biomass demand.

Table 5-38: Sustainable Energy Development programme

Development Challenges/Issue: Poor use of renewable energy			
Program outcomes and results: Reduction of annual biomass demand	Key Outcome Indicators	Status 2019/20	Target 2024/25
	Percentage reduction of annual biomass demand	3	20
	Increase the share of clean energy used for cooking	12	40
	Increase proportion of the population with access to electricity	35	70
Adopted Program Objectives	Adapted Interventions		
1) Increase adoption and use of clean energy.	i) Promote use of new renewable energy solutions (solar water heating, solar drying, solar cookers, wind water pumping solutions, solar water pumping solutions)		
Programme Outputs	Outputs and Targets	Actions (Strategic Activities)	Departments/ Actors

Table 5-39: Energy sources in Kanungu District

Energy Source	Hydropower	Solar	Fuel Wood	Bio-Gas
Proportion of Population using source (%)	0.07	0.87	99	0.06

The socio-baseline study collected information on the energy used by the households and findings revealed that most households rely on wood fuel (firewood and charcoal) as a source of energy for cooking. Other sources used include electricity, paraffin, solar energy and biogas. Solar was mostly used for lighting (63.4%). A considerable number of HHs (30.5%) use Paraffin/ kerosene for lighting, these are mainly households in the rural areas that are not connected to the grid.

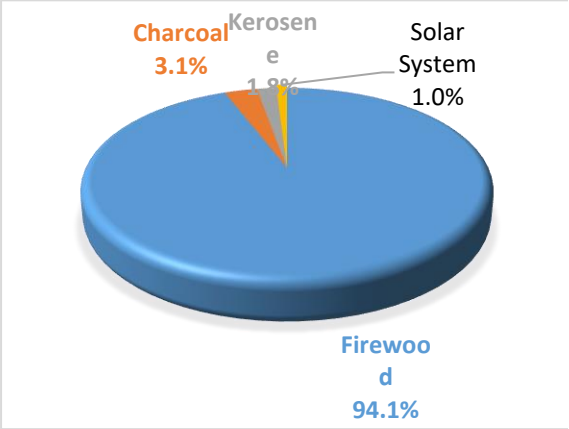


Figure5-69: Sources of energy for cooking

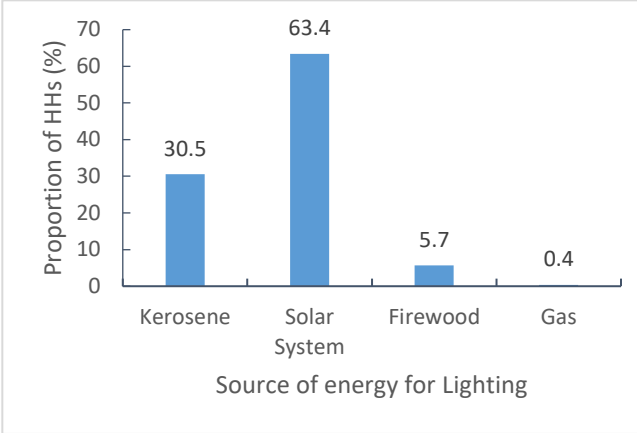


Figure5-70: Sources of energy for lighting

During the site inspection, it was observed that, in the rural areas fuel wood is mostly gathered by women from nearby woodlands, and thickets. Charcoal is popular within urban settings. However, to a small extent, especially in urban areas there is use of electricity for cooking. During an FGD held with women, they mentioned that getting firewood is a big challenge and at times costly; a bundle of firewood cost between 2,000 UGX and 6,000 UGX on average.

5.6.11 Health

Good heath is central to having a productive workforce, and healthcare provision is vital to the welfare of the community. The Uganda Health Sector Development Plan (HSDP) 2015/16-2019/20 is the medium-term plan driving the agenda of a healthy life for all Ugandans alongside the National Development Plan II (NDP II) and the National Health Policy (NHP II) 2011–2020. One of the fundamental goals for the HSDP is to contribute to the production of a healthy human capital for wealth creation through provision of equitable, safe and sustainable health services. In addition, among the guiding principles for the implementation of the NHP II is; being 'evidence-based' and 'forward-looking'. The sector development plan is in line with the Sustainable Development Goal (SDG) target 3.8 that advocates for achieving universal health coverage including financial risk protection, access to quality essential healthcare services and access to safe, effective, quality and affordable essential medicines and vaccines for all.

The district development plan 2020-2025 indicates that there is limited access to health facilities in Kanungu. The district has 52 health facilities: with the majority (about 50%) being HC IIs, 2 general hospitals. It is characterized by high rates of malnutrition with 35% of children stunted and 26% underweight (2016 UDHS The majority of the people lack access to food and most children aged less than five die from preventable diseases. The assumptions involved TFR to decline to 2.5 (TFR for DD) for low fertility, population doctor ratio is 10,000, population nurse ratio is 5,000, population per health centre is 20,000, population per hospital is 500,000 and population per bed is 1,000. The results show that by 2040 low fertility scenario, 249 doctors will be required as opposed to 279 for high fertility, 5 hospitals compared to 6 and 124 health centres as compared to 140 for high fertility scenario. The cost of delivering health services in Kanungu District as per WHO recommendations will exponentially increase from Ushs.44.76bn in 2020

to Ushs.51.69bn in 2025 with continuing high fertility. In contrast, with a declining fertility, we shall spend Ushs.50.63 by 2025 hence the accumulated savings of Ushs.1.06bn which wisely utilized can fully equip and maintain the existing health infrastructure and also support the additional health centres due to increase in population.

Nevertheless, the subcounty in the command area has got at least one health facility at level II. The HC IIs provide the first level of interaction between the formal health sector and the communities. These only provide outpatient care, community outreach services and linkages with the Village Health Teams (VHTs). Figure 5-38 below presents the number of health facilities within the project area.

Table 5-40: Some of the Health centres within the proposed command area

NO.	NAME OF FACILITY	LEVEL	OWNERSHIP
1.	Bihomborwa Health Centre	II	Government
2.	Kanungu Health Centre	IV	Government
3.	Kanyantorogo Health Centre	III	Government
4.	Katete Health Centre	III	Government
5.	Kihiihi Health Centre	IV	Government
6.	Matanda Health Centre	III	Government
7.	Nyakinoni Health Centre	II	Government
8.	Nyamirama Health Centre	III	Government
9.	Samaria Health Centre	II	Government
10	Kibimbiri Health Centre	II	Government

Within the dam area, table below highlights the health centers found there.

Table 5-41: Some of the Health centers within the dam/reservoir area

SN.	Name of facility	Level	Ownership
1	Kanyantorogo Gvt HC III	HC III	Government
2	Katete HC III	HC III	Government
3	Kihanda HC II	HC II	Private Not for Profit (PNFP)

Common illnesses

Findings of the updated socioeconomic survey indicated that majority of the households (83.9%) had malaria as the common disease. Results also indicated that majority (90.4%) of the households affirmed that at least one member of their family had fallen sick in the last 6 months. The conditions/diseases suffered included flu/cough, Skin diseases, Intestinal worms, diarrhea diseases, asthma, diabetes, pressure and typhoid among others (Figure 5-71). Hypertension was recorded as the predominant long-term illness in the project area with 24.1% followed by diabetes at 18.7%. Overall, an estimated 89.2% of the household heads mentioned that they seek treatment from government health facilities, while others go to private hospitals (3.7%), NGOs hospitals at 3.7% and private clinics (3.4%) among others.

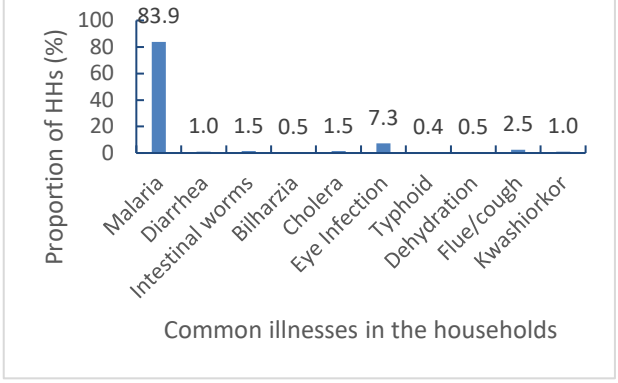


Figure 5-71: Diseases/accidents suffered in the last 6 months

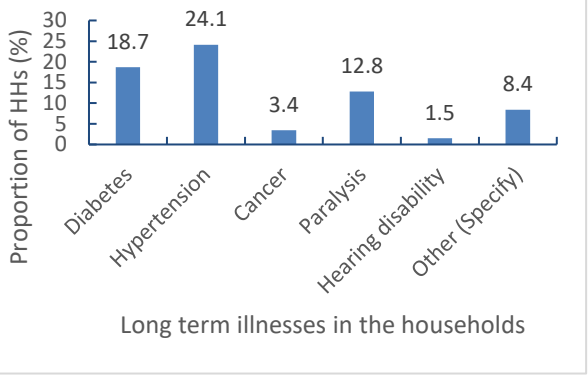


Figure5-72: long term illness.

Access to Health services

It was established that various sources of health care services are sought in the management of health problems by communities. These included: medical attention from health centers, homebased health services especially those provided by Village Health Teams (VHTs) use of local herbs and seeking traditional healers especially for illnesses that are considered to be spiritual based or where conventional medicine is not considered as a remedy. Through interviews, the communities noted that their members usually seek faith-based healing especially from Pentecostal churches and sometimes mosques.

i. Command area

Findings of the household survey showed that majority (28.4%) of the households in the command area have to travel over 5km to access a health facility. 21.7% of the household heads mentioned that they move between 1.5-2.5km, 18.8% 0.5km respectively as shown the figure below.

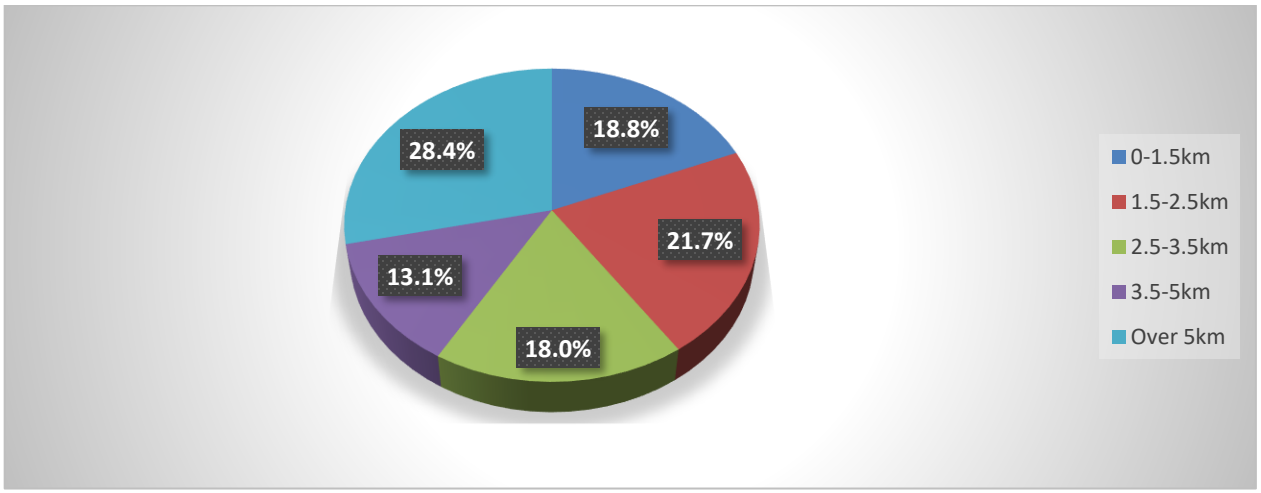


Figure5-73: Distance to the nearest health facility in the command area

ii. Dam/reservoir site

On the other hand, findings of the household survey indicated that in the dam/reservoir area, the majority of the respondents (28.5%) travel below 1.5km to access a health facility followed by those who travel for 1.5km – 2.5km. Nonetheless, a significant proportion of the respondents (19.7%) reported traveling over 5km to access health services, as indicated in the figure below.

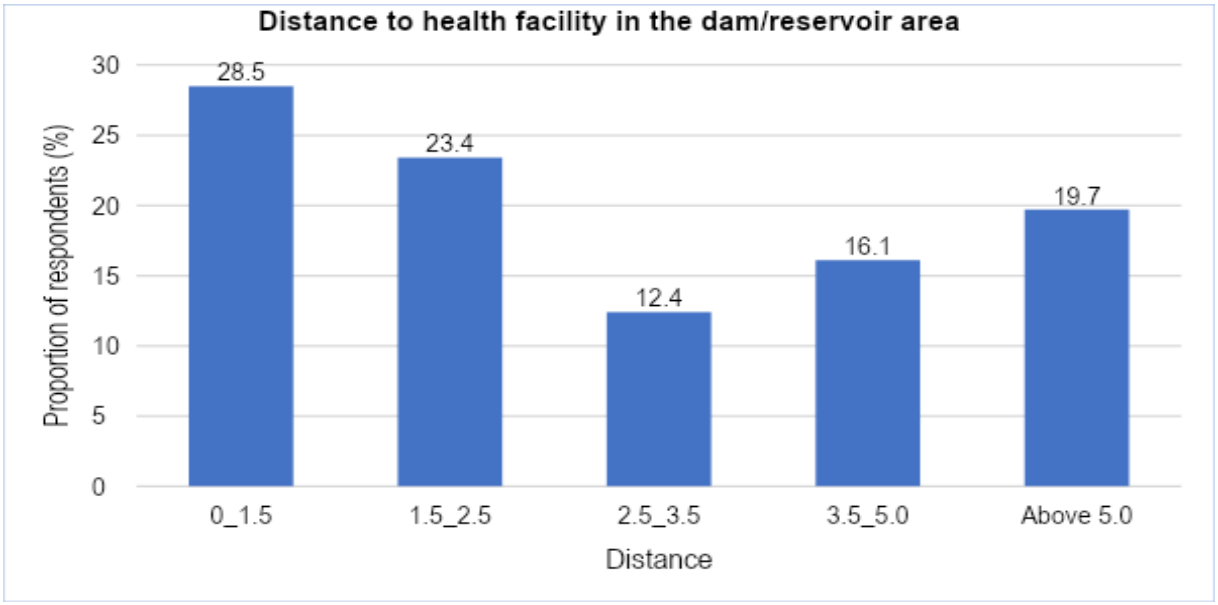


Figure5-74: Distance to the nearest health facility in the dam/reservoir area

Photo 5-25: Bihomborwa Health Center II in Bihomborwa

Photo 5-26: Afya Njema clinic in Kihihi Town Council

Use of mosquito nets

During the study, it was observed that the usage of mosquito nets in the project areas is being embraced by the communities with majority (91.9%) of the respondents acknowledging that people in their households use mosquito nets whereas only 8.1% mentioned that they do not use them.

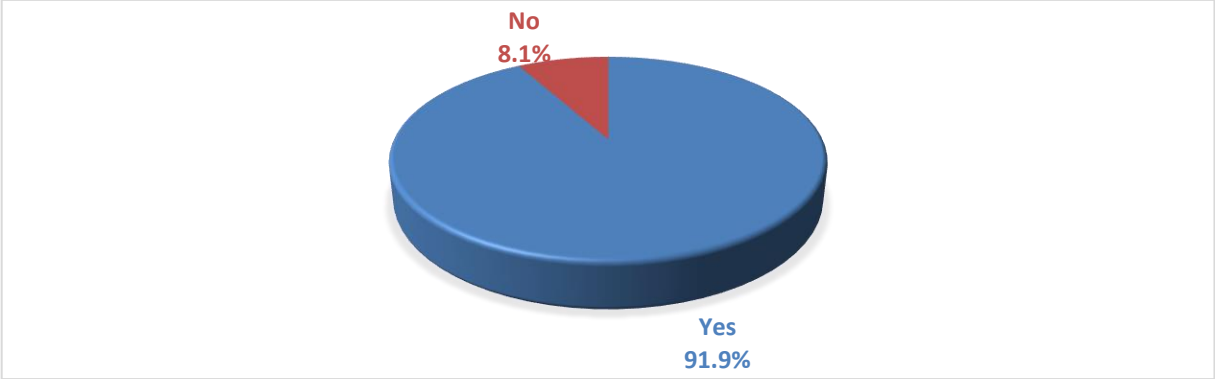


Figure5-75:: Mosquito net usage within the project area.

Family planning use

In regard to family planning, it was ascertained that 42.6% of households had members who use family planning methods while 57.4% did not. Some of the family planning practices adopted included, hormonal contraception including injectable such as Depo-Provera as the most common method. Other methods included breast feeding, cultural methods and vasectomy.

HIV/AIDS

According to the household survey 98.6% of respondents were aware of the existence of HIV/AIDS and ways in which it is contracted. Ways of HIV transmission stated as highlighted during interviews included, unprotected sex, infected blood transfusion, sharing of sharp instruments and mother to child transmission. According to survey the commonest way of prevention of contraction and spread of the disease was identified to be proper condom use, abstinence and faithfulness and safe childbirth. Since these strategies

already exist in the community, the HIV/AIDS mitigation plans as formulated by the developer need to build on these.

According to key informant interviews at the district level indicated that there are several interventions within the district aimed at ensuring reduction of HIV including counseling and testing, community outreach, seminars and community camps. There are also a number of NGOs with a focus on HIV and Aids within the project area. These NGOs include, world vision Uganda, Aids commission, save the children among others. There also community groupings such as women groups whose objective among others is sensitizing masses about HIV and aids.

Health problems and Challenges

During the interviews and FGDs, there was general concurrence that the health facilities and services offered from there were in appalling situation. Such a situation was qualified by inadequate medicines resulting from infrequent stocks from national medical stores and long distance to health facilities.

5.6.12 Waste management

Inadequate and inappropriate waste disposal has serious implications on the general cleanliness of the environment and significantly contributes to pollution of water resources. There are three main approaches to waste management in the beneficiary communities: (1) Agricultural burning, (2) Digging a hole and (3) Communal dumping. Nearly three quarters, 78.6% of the respondents mentioned that they dispose household waste in shallow pits/ dig a hole followed by 11.6% respondents who just burn their waste, other details of disposal shown on Figure5-76. This indicated, the households have basic knowledge of keeping their households clean and dangerous of disposing waste in a wrong manner to avoid disease which may come along with wrong waste management at household level. During the implementation of the project, farmers and communities will be sensitized about the risks associated with opening burning of agricultural refuse/waste to their health and the environment. The ICRP Implementation Team shall work with Kanungu District LG to promote climate smart agriculture.

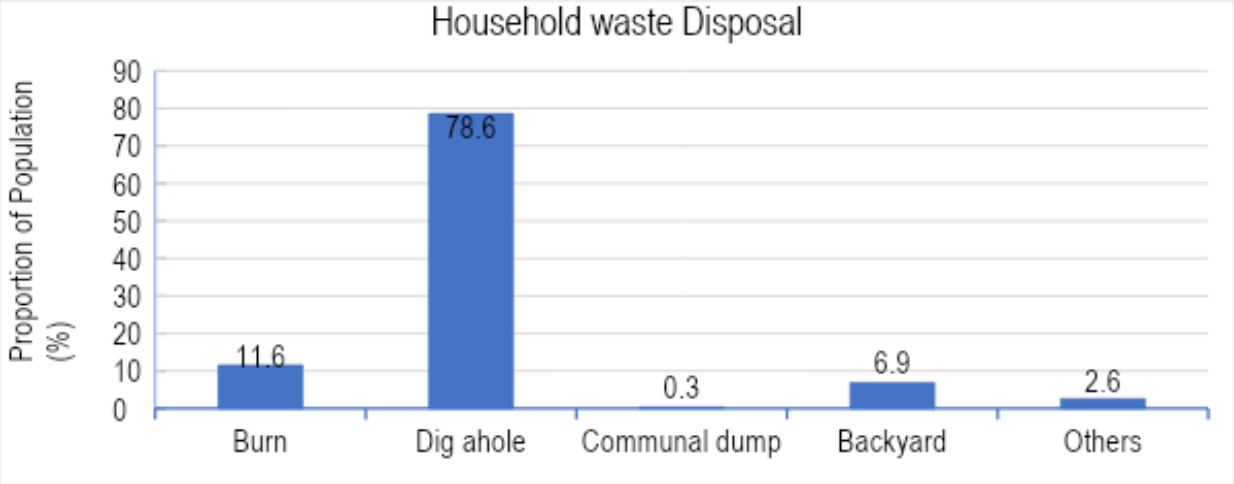


Figure5-76: Solid Waste disposal methods

Of critical importance to water source protection and prevention of diarrheal diseases is human excreta disposal. Findings of the household survey showed that majority of the respondents had pit latrines (96.4%) followed by pour/ flash toilets (2.6%) a few of them using bush/ open disposal (0.3%) as shown in Figure:5-77. The households that lack the toilet facilities either practice open defecation or utilize their neighbor's' latrines. The reasons pointed out for lack of latrine included hilly terrain that makes it difficult to construct them and lack of money required.

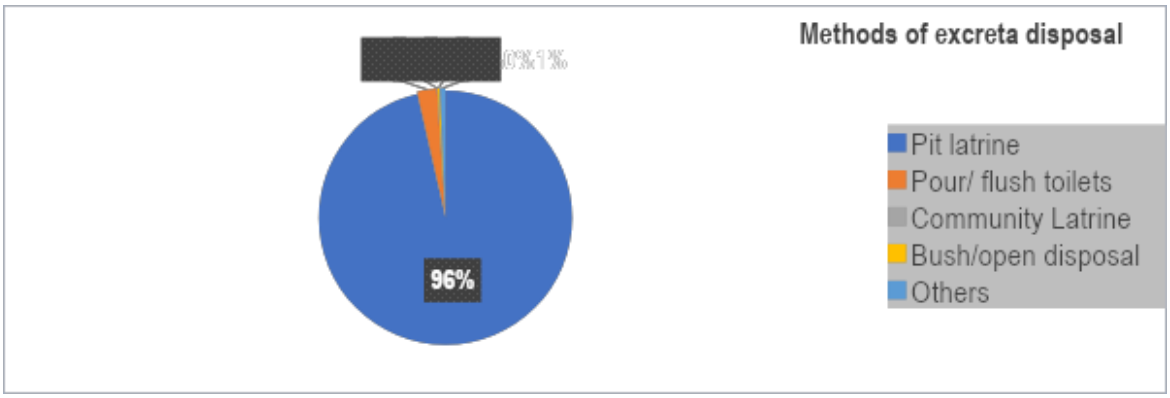


Figure:5-77: Methods of human excreta disposal

Photo 5-27: Traditional pit latrine in Bihomborwa

Photo 5-28: Latrine in Kihihi Town Council

5.6.13 Water supply

The right to water is directly stipulated in the Constitution of the Republic of Uganda under the National Objectives and Directive Principles of State Policy. Objective XIV articulates social and economic rights, including the right to water, health and an adequate standard of living. According to SDG No.6, it is a commitment to achieve universal and equitable access to safe and affordable drinking water for all by 2030 which can only be achieved through piped water supplies.

The water services in the district have greatly improved. Access to safe and clean water has increased in Kanungu District with an average increase from 71% in 2014 to 83% in 2019 while Latrine coverage increased to 94%. Under Promotion of rainwater harvesting, 8 community tanks were constructed in hard-to-reach areas, 4 Gravity Flow Schemes were constructed namely Kiringa GFS Kinaaba GFS and Mafuga GFS and Bukunga GFS. The percentage of functional rural water point sources has also declined from 79% in 2016 to 34% in 2019/20. This is mainly attributed to functional Water user committees whose rate stands at 85%. The poor performance of water and sanitation related indicators partly explains the high morbidity rate in the district due to water borne diseases especially among children, pregnant mothers and the elderly. This is attributed to poor water chain management. According to Kanungu DDP 2020/21-2021/25, Basing on the water atlas and current interventions by the district, water coverage stands at 94.5% and functionality stands at 88.5%.

Table 5-32: Safe water sources in Kanungu District

Sources of Water	Households
Protected springs	1,021
Shallow wells	46
Deep boreholes	79
Yard Taps for public use	918
Kiosks	36
Public stand posts	1,030

Source: (Kanungu DDP 2015/16-2019/20)

The sources of water in the project area included communal boreholes, rivers, rain water, taps and protected springs. Findings of the socioeconomic survey showed that majority (42.6%) of the household heads fetch water from yard taps/public tap stands, 24.7% mentioned they fetch water from rivers and streams in the project area whereas 19.2% from protected springs and 5.0% harvest rainwater as showed in Figure 5-91.

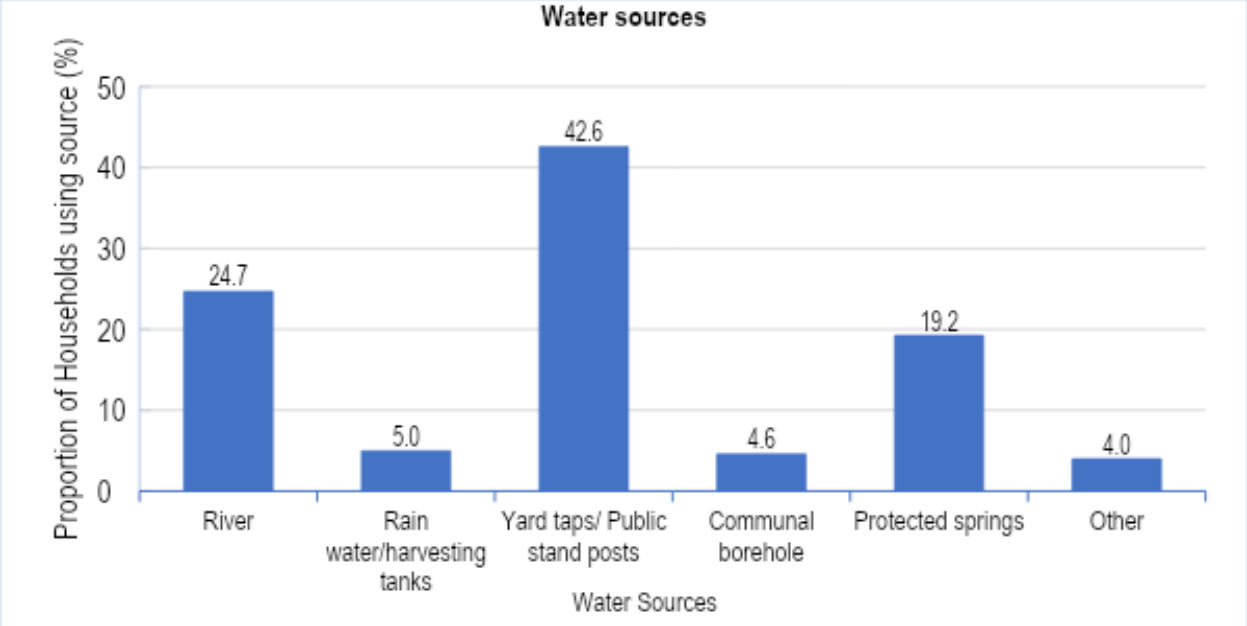


Figure5-78: Water sources used by household heads.

In the dam/reservoir area however, findings indicated that majority (40.9%) of the households fetch water from the river followed by those that fetch from yard taps/public stand posts (25.5%), protected springs (23.4%) and those that practice rainwater harvesting (21/9%), as indicated in the figure below.

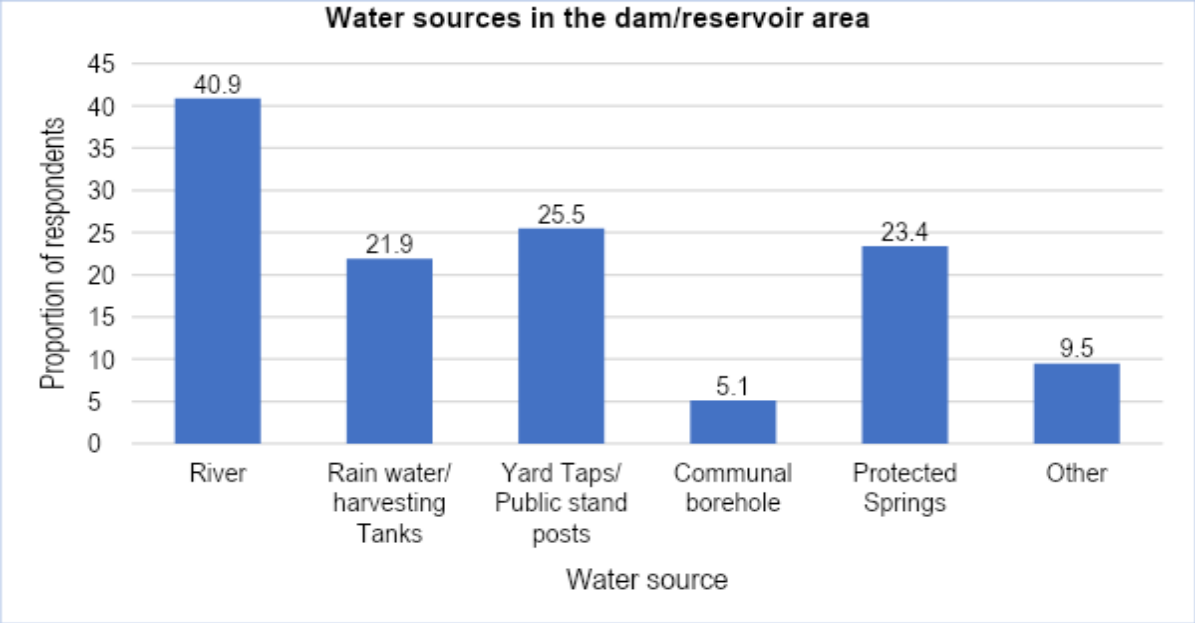


Figure5-79: Major water sources used in the dam/reservoir.

Distance to water sources

i. Command area extent

Regarding distance travelled to access water, majority (30.6%) of respondents mentioned that they move over 5km to access safe water, 20.2% access water within a radius of 1.5 km – 2.5 km and others as shown below

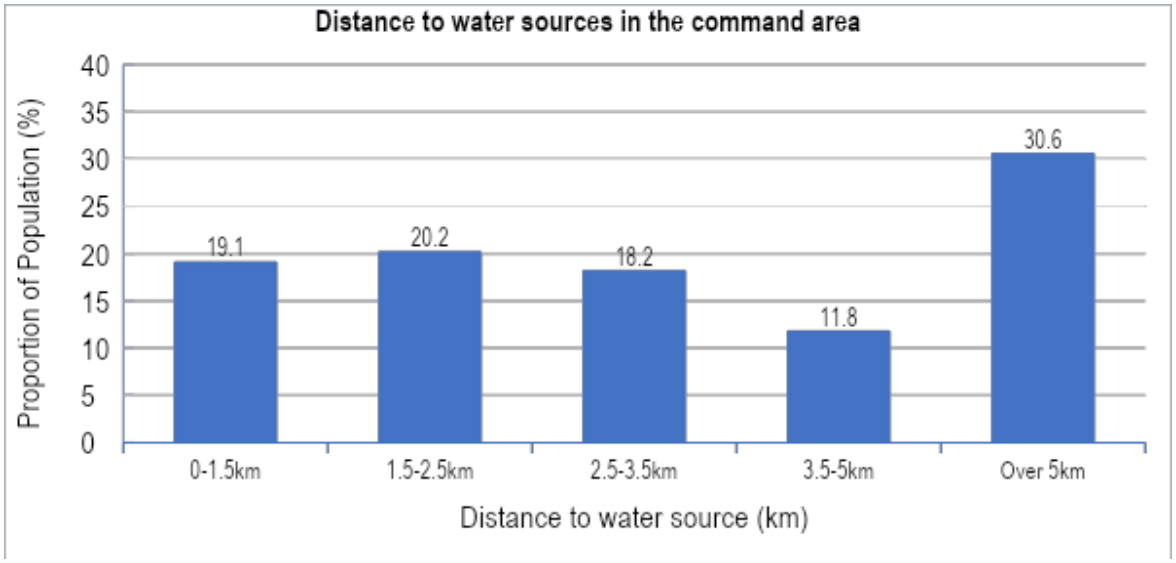


Figure5-80: distance to water sources in the command area

ii. Dam/reservoir area

On the other hand, findings of the survey indicated that majority of the respondents in this area travel relatively shorter distances to access water as compared to their counterparts in the command area. Majority of the household heads (60.6%) reported to move for between 0-1.5 km to access water, 29.2% reported to travel for 1.5-2.5 Km whereas only 1.5% reported to move over 5km in oder to access a water source. This could be attributed to the close proximity of these communities to River Kiruruma.

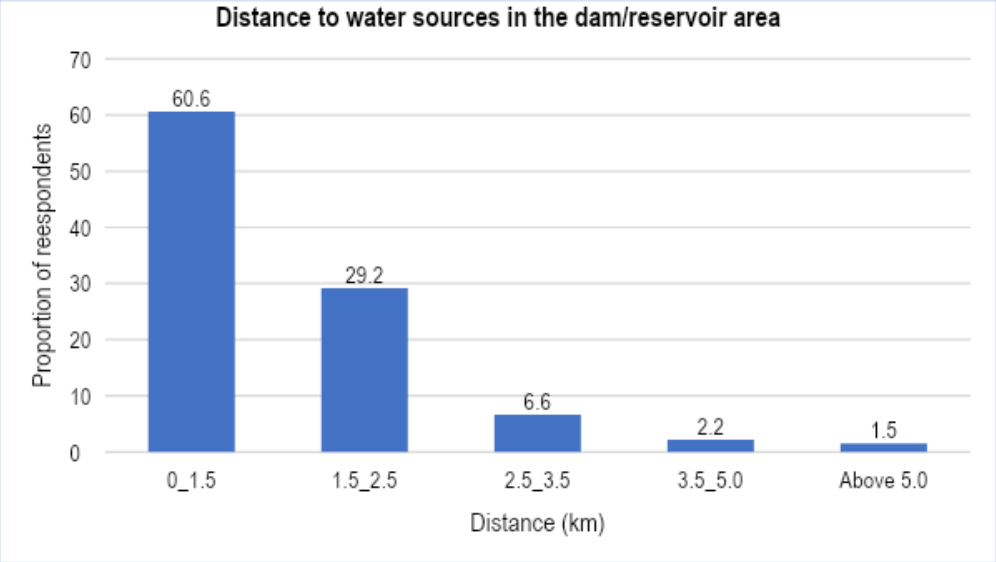


Figure 5-81 Distance to water sources in the dam/reservoir area

Water for production

Regarding production, irrigation is not yet widely adopted in the project area although a few farmers near streams and rivers draw water for limited watering of their crops (on about 1-2 acres) during the dry season. Findings of the survey indicated that majority (94.8%) of the farmers don't irrigate their crops and only depend on the rain to water their crops whereas only 5.2% households were practicing irrigation at a small scale and it was mainly those involved in vegetable and rice farming. However according to the district development plan 2020-2025 there is urgent plans for the Construction of water for Agricultural production facilities (100 solar powered irrigation schemes, 2 valley tanks constructed, 5 gravity surface water irrigation schemes, 2120 soil and water conservation demonstration sites) nexus green is also expanding its operation in the project district to offer small scale irrigation facilities in the project area.

5.6.14 Communication and access to information

According to the National ICT Policy framework, information is a resource that activates various sectors of the economy, making it possible for producers and consumers to be linked to markets. Availability of

information provides an opportunity for the public to participate meaningfully in governance through engaging in public discussions and contributing to decision-making.

Findings of the socioeconomic survey conducted indicated that information in the project area is best received through radios followed by community meetings. The most listened to radio in the project area are Radio Kinkiizi, Kanungu Broadcasting Services, and Kanungu FM Voice of Kigezi. Other stations listened to include Voice of Rukungiri, Radio west, Grace Radio and Radio Uganda among others.

The district is connected to a number of telecommunication networks like MTN Uganda (consultations with the community revealed that this is the most commonly used network in the project area), UTL, Airtel Uganda and Orange Uganda. It is also connected to satellite and free to air television stations such as DSTV and StarTimes TV and others.

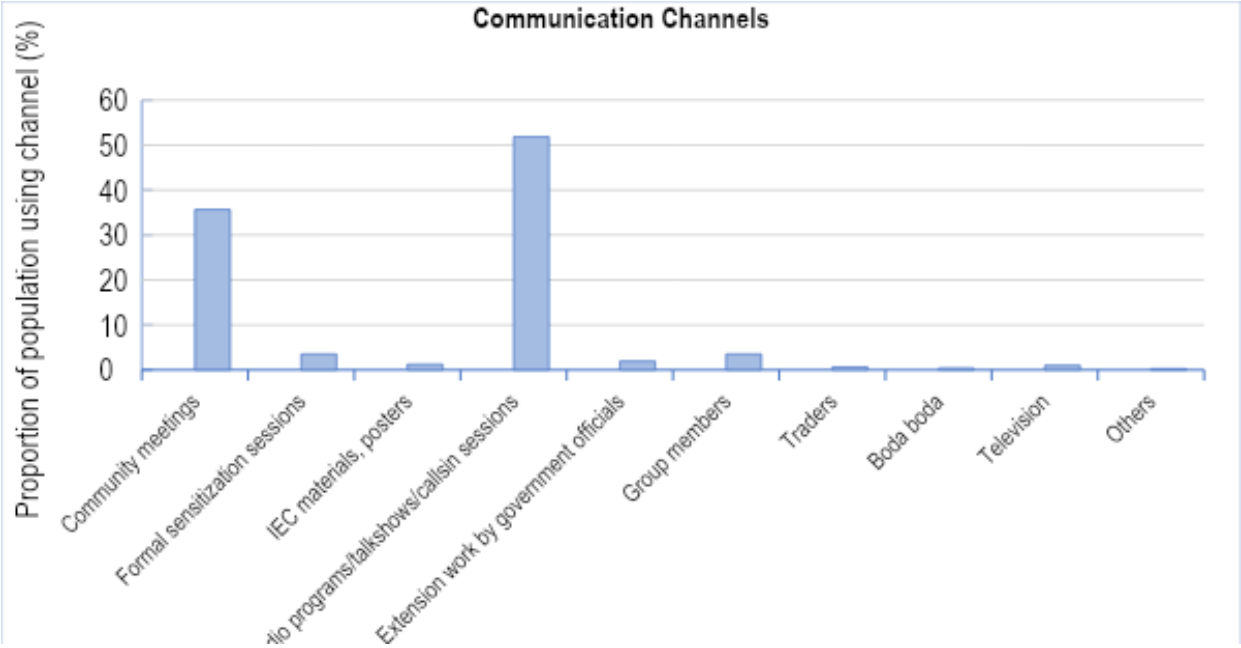


Figure: 5-82: Channels of information dissemination

These channels of communication especially Radios and community meetings and were used during the ESIA studies especially for community mobilization and proved to be successful; these can thus be used for information dissemination throughout all project implementation phases.

Other places of information sharing in the project area include, churches, mosques, drinking places, community playgrounds and burial places.

5.6.15 Employment

Unemployment and underemployment especially among the youth is on the increase in Kanungu District. Approximately 4.7% of the total labour force in Kanungu is unemployed. This means that Kanungu labour force is young, untrained, unskilled and rural based. Although the private sector has emerged as the major conduit for generating wage employment, the high demand for jobs supersedes the available employment opportunities (Kanungu DDP 2020-2025).

During stakeholder engagements and survey, the majority of the respondents cited unemployment as a major concern in the area. The community made a request for contractors to consider the local people especially youth for any available employment opportunities during project implementation. The working youth were mainly involved in Boda boda riding, small retail shops and motorcycle spare parts vending which characteristically generate low-incomes.

Photo 5-29: Youth playing pool game in Rukarara

Photo 5-30: Chapati business in the project area

Formal employment opportunities are limited in the project area. The institutions that provide formal employment opportunities to the local people include health centers, schools, cooperative and credit societies and the local government among others.

5.6.16 Sites of Cultural or Religious Significance

An Archaeological and Cultural heritage baseline survey was undertaken in November 2019 and September 2023 to determine the type of Physical Cultural Resources (PCRs) present in the area and to assess the impact of the schemes on these resources in case they came into contact with the project infrastructure. Whereas local persons could reveal historical cultural orientation of the project area, a chance find procedure is recommended during implementation of the project.

Cultural Heritage at Community level

Focal point discussions in all the five sub counties of Kanungu District described the Banyabitumbi community tree as the outstanding cultural heritage resource in the area, located in Kihihi Town Council, Rwanga ward and is looked after by the Banyabutumbi community association. The tree used to be called Oruti rugamba because the locals say ancestral spirits used to speak from the tree at night, this tree marks the location where the Banyabitumbi community used to Crown their traditional rulers. The location is held in high regard by the community as a historical site. The coordinates of the spot are UTM 35N 0799140, 9917050. In the updated study there is one location in Matanda village where the traditional Bakiga tribe art of metal implement production (Black smiths) is still being practiced at Kitazimuruka, UTM 35M 0805908 9929868 (black smith called Dabulensio Rukwesi). Photos below show the wife of the black smith demonstrating the production method and the Banyabutumbi tree in Rwanga Ward, Kihihi Town Council.

Photo 5-31: Banyabutumbi tree in Rwanga ward Kihiihi Town Council (0799140, 9917050), Matanda Blacksmithing site 0805908 9929868

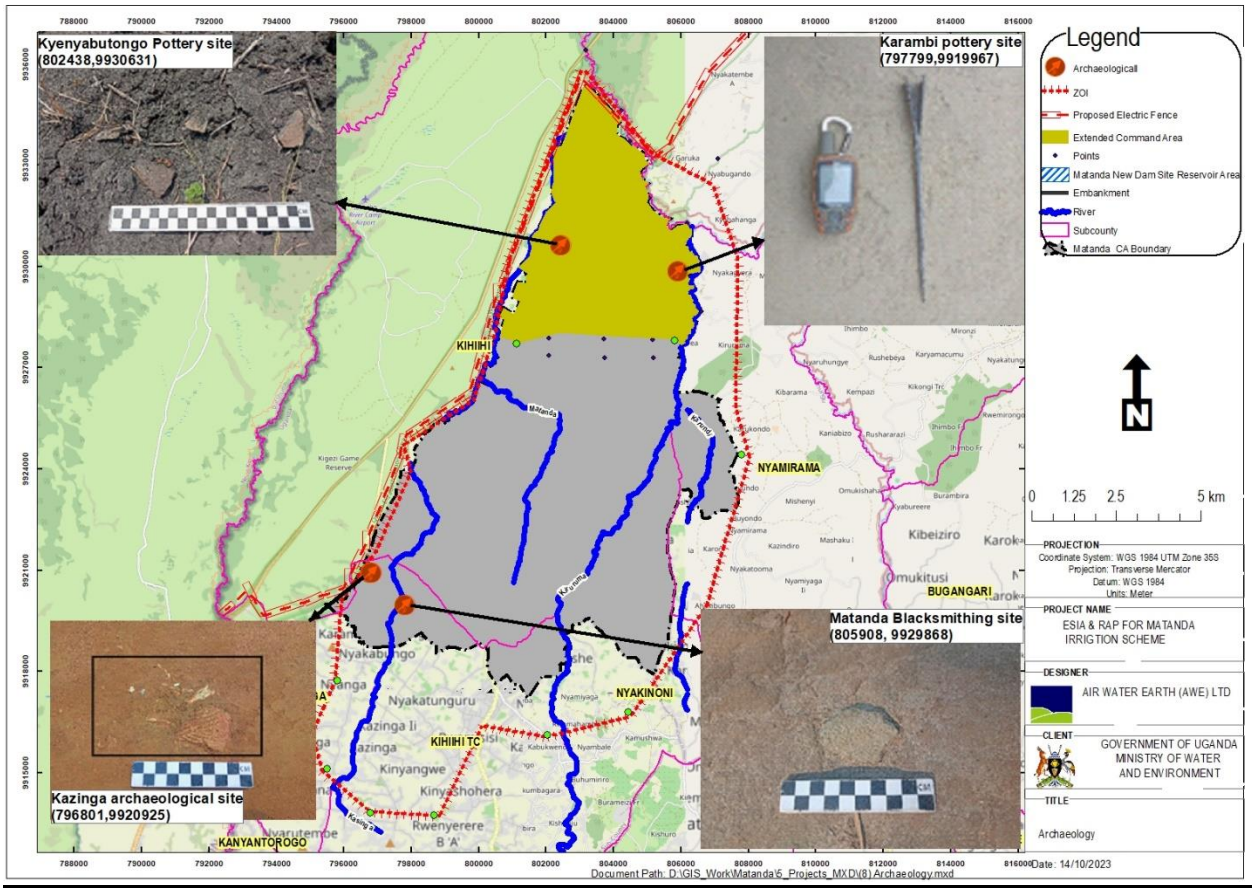


Figure: 5-83: *Archeological sites of the proposed Matanda Irrigation Scheme*

Matanda Blacksmithing site

The technology of blacksmithing is still evident in the project area. The artisan uses the same old technology/furnace set up in the early iron smelting period. Instead of using iron ore, scrap metals are being utilized but with closely similar technology as the early iron smelters. A big furnace with a big tuyere made from wood and clay at the tip was recorded. According to the custodian Rukwesi Dabulensio (80 years of Age), he learnt the craft from his parents. Therefore, the technique has been hereditary, and he equally trained his children and other youth in the village to carry on the practice. Tools made include pickaxes, Pangas, knives, arrowheads, sickles, fishing spears. This is a significant finding within the project area and shall be preserved.

Photo 5-32 Deus Muyambi – Kihihi Subcounty chief holding a traditional tool for harvesting bananas and some of the tools from the black smith site in Matanda

Cultural heritage at Household level

Community consultations revealed that households in the project area possessed graves for family members. The graves range from modern Cemented graves to the ordinary stone covered mud mounds. The population is attached to their graves and queries were made about the effect on the graves by the project activities. Although the graves are located within compounds of households that lay within the zone of influence, they are outside the irrigable area. There were no household shrines in the area observed. The population has adopted modern religions of Christianity and Islam.

Archaeological resources

Transect walks and test pits in the project area revealed that the area contained pot shards. The pot shards (broken pottery) were of both modern and late iron age. The presence of late iron age pot shards indicates that settled village communities existed in the area as early as 500 years from the present time. The population do not find any importance in broken pottery pieces and were amused by queries on these materials.

Photo 5-33 Pot shards observed in Bihomborwa, Pot shards found in Kyenyabutongo test unit and bones recovered. (a, b and c = Late Iron Age pottery and d= Kansyore branded motif) in the late iron age.

5.7 SCHEME ENVIRONMENTAL FLOW REGIME

5.7.1 Selection of study method(s)

Long term solutions to river flow management require a holistic approach that includes geology, fluvial morphology, sediment transport, riparian conditions, biological habitat and interactions, and water quality, both in temporal and spatial sense. Methodologies for the holistic approaches include: (i) Instream Flow Incremental Methodology (IFIM), (ii) Building Block Methodology (BBM), (iii) Ecological Limits of Hydrologic Alteration (ELOHA), and (iv) Downstream Response to Imposed Flows Transformation (DRIFT), among others.

IFIM links simulations of local channel hydraulics over a range of discharges with data on the hydraulic conditions in which selected species (usually fish) are most frequently found. The output plot of Weighted Usable Area (WUA) versus discharge indicates how these hydraulic habitats increase or decrease in area with discharge fluctuations, providing a simple negotiation and management tool (King et al., 2004).

DRIFT is designed to describe selected potential flow regimes, each linked to the predicted: (i) biophysical consequences in terms of condition of the river ecosystem; (ii) socio-economic consequences for subsistence users of the river, resulting from the changing river condition; and (iii) water yield of the scheme (King et al., 2004). ELOHA on the other hand, is a framework for establishing regional environmental flow standards.

A holistic consideration of every aspect of flow and sediment regime, river and riparian morphology, and their associations with the life cycles of the aquatic biota requires a high degree of knowledge about seasonal and life-stage requirements of species and inter-relationships of the various instream values and therefore the methodology chosen is largely influenced by the quantity and quality of information available.

The Building Block Methodology (BBM) is a prescriptive approach aimed at constructing a flow regime for maintaining a river in a predetermined condition. It is based on the concept that some flows within the complete hydrological regime are more important than others for the maintenance of the river ecosystem,

and that these flows can be identified, and described in terms of their magnitude, duration, timing, and frequency. The BBM differs from DRIFT only on the importance of the socio-economic relevance of the subsistence users of the river.

Like IFIM, the BBM aims at maintaining a prescribed condition based in a high degree of knowledge about flow requirements of the various aspects of the ecosystem. However, identification of flow requirements in the BBM is based more on the natural flow paradigm than on an understanding of physical and biological relationships. A basic assumption of the BBM, and the major point of departure from IFIM, is that biota associated with a river can cope with naturally occurring low flows, that occur often, and may be reliant on higher flow conditions. In addition, flows that are not characteristic of the river will constitute an atypical disturbance to the ecosystem and could fundamentally change its character (Jowett et al. 2008).

The Building Block Methodology was employed in this study. In the BBM the following assumptions are made (King et al, 2008):

- The biota associated with a river can cope with those low flow conditions that naturally occur in it often and may be reliant on higher flow conditions that naturally occur in it at certain times. This assumption reflects the thinking that the flows that are a normal characteristic of a specific river, no matter how extreme, variable, or unpredictable they may be, are ones to which the riverine species characteristic of that river are adapted and on which they may be reliant. On the other hand, flows that are not characteristic of that river will constitute an atypical disturbance to the riverine ecosystem and could fundamentally change its character.
- Identification of what are felt to be the most important components of the natural flow regime and their incorporation as part of the modified flow regime will facilitate maintenance of the natural biota and natural functioning of the river.
- Certain kinds of flow influence channel geomorphology more than others do. Identification of such flows and their incorporation into the modified flow regime will aid maintenance of the natural channel structure and diversity of physical biotopes.
- In total, the flows incorporated into the modified flow regime will constitute the Environmental Flow Regime (EFR) for the river. As the minimum acceptable value will have been entered for each flow component incorporated, the EFR describes, in space and time, the minimum amount of water assumed to facilitate maintenance of the river at some predefined desired state.

The methodology uses detailed cross-sections and stage-discharge data at Instream Flow Requirement (IFR) sites to determine water levels which will inundate shallow riffle areas, stream banks, riparian vegetation, backwater areas and floodplains, or stimulate important biological responses. The flows required to maintain natural geomorphological processes and channel morphology, and water dependent wildlife (frogs, reptiles, mammals, and birds) are also considered. Management objectives are set by each specialist and the specific flows required are identified month by month, starting with the low flows. Each specialist proposes the low flow needed to achieve habitat and other conditions (e.g., depths and velocities suitable for certain fish species). Hydraulics is then used to interpret the implications of the flows described in terms of depth, wetted

perimeter, velocity, or areas inundated, using the surveyed cross-sections and plots of various hydraulic relationships. After reconciling the recommended flows from the different specialists, details of the low flows are added one by one to a blank IFR table of discharge (rows) versus calendar months (columns). Equally, capping flows (the recommended upper limits to the flows which may be passed through a river reach in a naturally low flow month are recommended. Then small freshes and flood flows are defined, with each of the latter being described in terms of five criteria: magnitude, timing, frequency, duration and hydrograph shape. Flow sequences and hydrograph shapes drawn from the hydrological data on the river's natural flow regime are used to define these five characteristics of freshes and floods. The IFR table is then filled out initially to quantify the IFR for normal river maintenance, with the desired future state as the target for the flow recommendations.

This is followed with the definition of a range of flows to be maintained during drought conditions. These 'drought' flows are required to ensure continued existence of aquatic species but would not be expected to sustain reproduction and recruitment of most species, although some hardy species might be able to breed under drought conditions. Thus, drought flows are intended to maintain the resilience of the aquatic ecosystem under conditions of extreme stress. Droughts are regarded as natural events, linked to regional climate and rainfall/run-off characteristics of the catchment. In the Building Block Methodology, it is understood that environmental flows would be allowed to fall to the recommended drought levels only during natural drought events, and not because of water abstraction or river regulation. As a rule, the timing of flows during drought conditions is tied in with natural flow events in the river system.

After the completion of the IFR tables, a flow matching exercise is undertaken to compare the flow requirements recommended for the different IFR sites to check that there are no major discrepancies between sites, or between the IFR recommendations and the historical flow regime.

5.7.2 Survey area and survey objectives

The overall catchment where the Irrigation scheme command is situated covers a catchment area drained by 10 rivers and streams. The average daily flows of these rivers are R. Ishasha (2.53 m^3/s), R. Ibalya (1.33 m^3/s), R. Kiruruma (1.84 m^3/s), R. Karundi (0.56 m^3/s), R. Mashekwe (1.35 m^3/s), R. Kakindo (2.8 m^3/s), R. Rushaya (2.12 m^3/s), R. Mitano (15.45 m^3/s) all draining into R. Ntungwe (21.64 m^3/s). The Figure: 5-84 below shows the schematic of the command area and the rivers draining and bounding the study area. The irrigation scheme will be abstracting all its water from river Kiruruma downstream of river Ibalya.

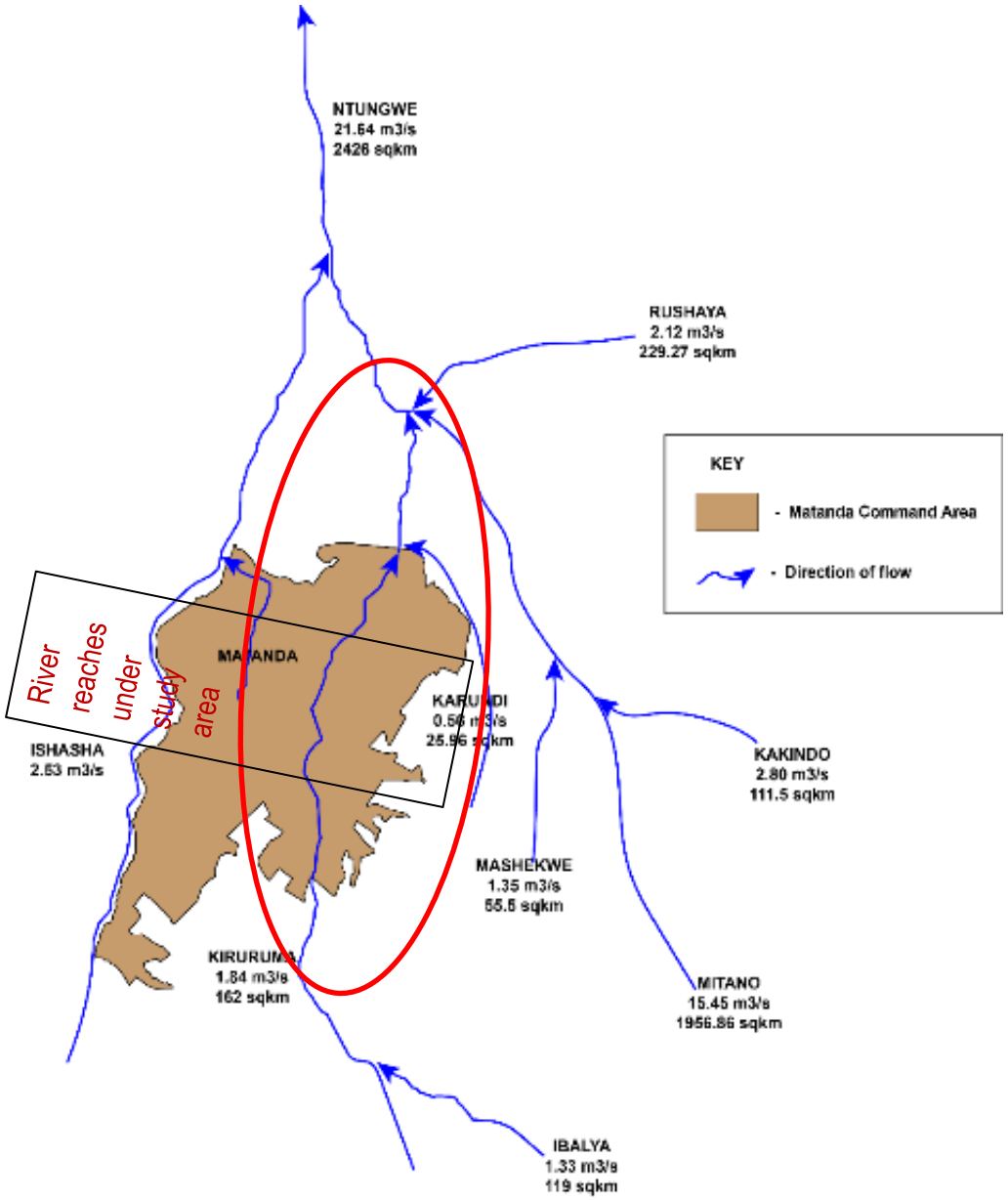


Figure: 5-84: *Extent of area covered by the scheme and the rivers draining and/or bounding the study area*

According to King et al., (2008), impact studies shall be confined to that portion of the river system actually affected by a particular activity. The area under this study is presented in Figure: 5-84 above. The river section under study begins from the location of the proposed dam to the point at which river Kiruruma joins river Mitano. Environmental conditions related to water resources that are studied in this report include the following: Watershed, Channel structure and Flow regime.

5.7.3 Hydrologic Issues

Changes in hydrological regime may result from a wide variety of factors some controllable and others uncontrollable. This section explores issues concerning: (1) factors affecting the variability of water supplies, (2) quantification of changes in stream flow, and (3) issues related to reservoir operation.

Water budgets: The balance among the various components of the hydrologic cycle is of crucial importance in the coexistence of humans and rivers. Scattered amid the inherent uncertainties of annual precipitation patterns are factors that change the distribution of water among the pathways of hydrologic cycle.
The basic concept of the water budget can be summarized as follows:

$$R = P - ET - \Delta SM - \Delta GWS$$

Where R is open channel runoff, P is precipitation, ET is evapotranspiration, $-\Delta SM$ is the change in soil moisture, and ΔGWS is the change in groundwater storage. Presents the contributing areas to the flow of R. Kiruruma based on important reference points within the study area.

The water balance analysis was based on the two hydrological station Number 84270 on river Kiruruma and station number 84270 on R. Mitano as indicated on the map in Figure 5-102. Establishment of flow at various points in the study area was based on interpolation based on proportional areas on the hydrological station number 84267 on river Kiruruma. Establishment of seasonal flows was based on the same station as it is an average representation of both the upstream and downstream sections in the study area.

For the analysis of rainfall, three meteorological stations at Kanungu, Mafuga and Rukingiri were used. Two of the stations are plotted on the map, however, the locations of these stations are presented in the table below.

Table 5-42 List of meteorological stations used in the hydrological study.

No.	STN_ID	NAME	LONGITUDE	LATITUDE
1	90290020	Kanungu	29.767	-0.900
2	90290040	Rukungiri	29.933	-0.783
3	91290060	Mafuga	29.883	-1.050

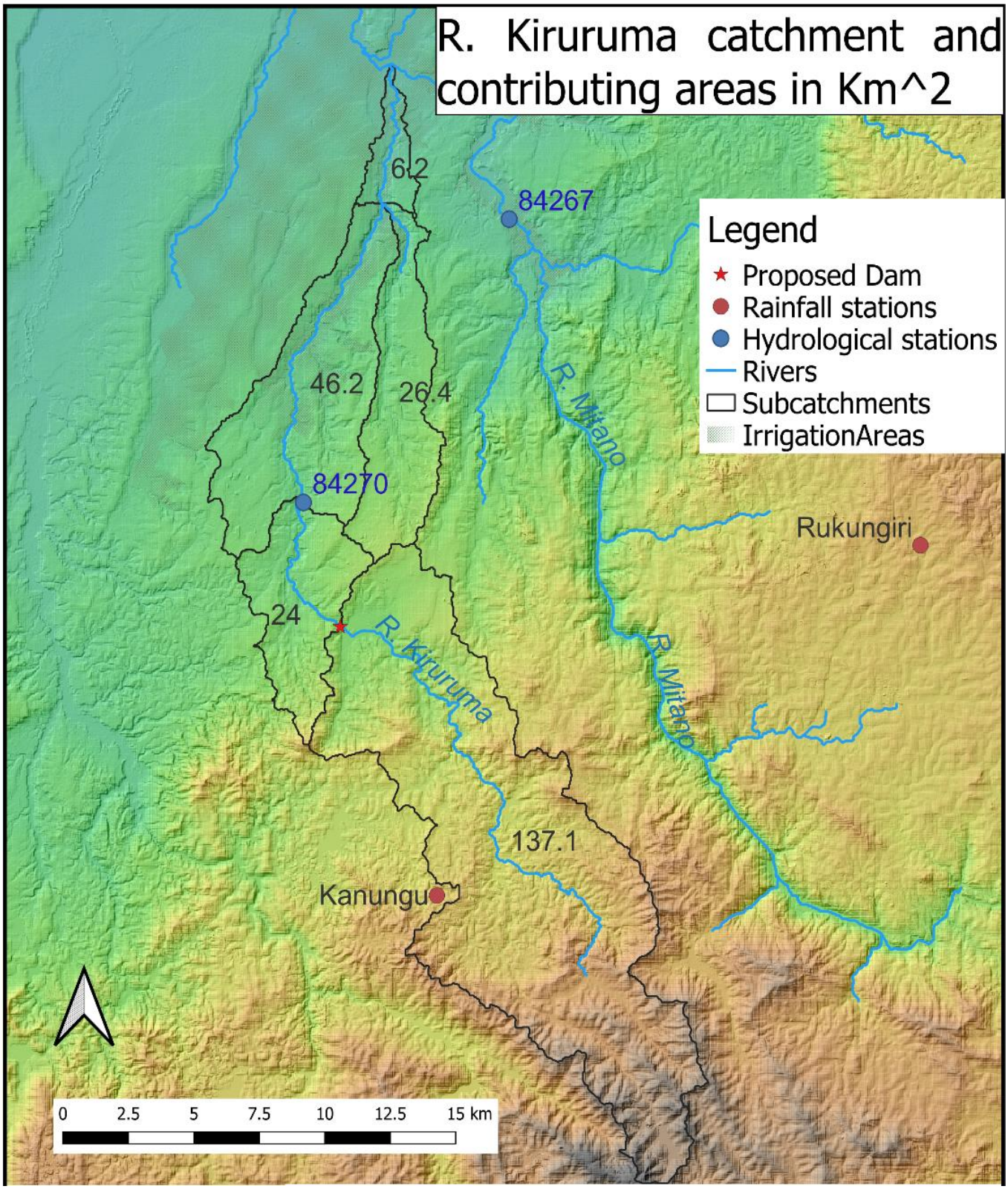


Figure 5-85: R. Kiruruma catchment and relevant sub-catchments

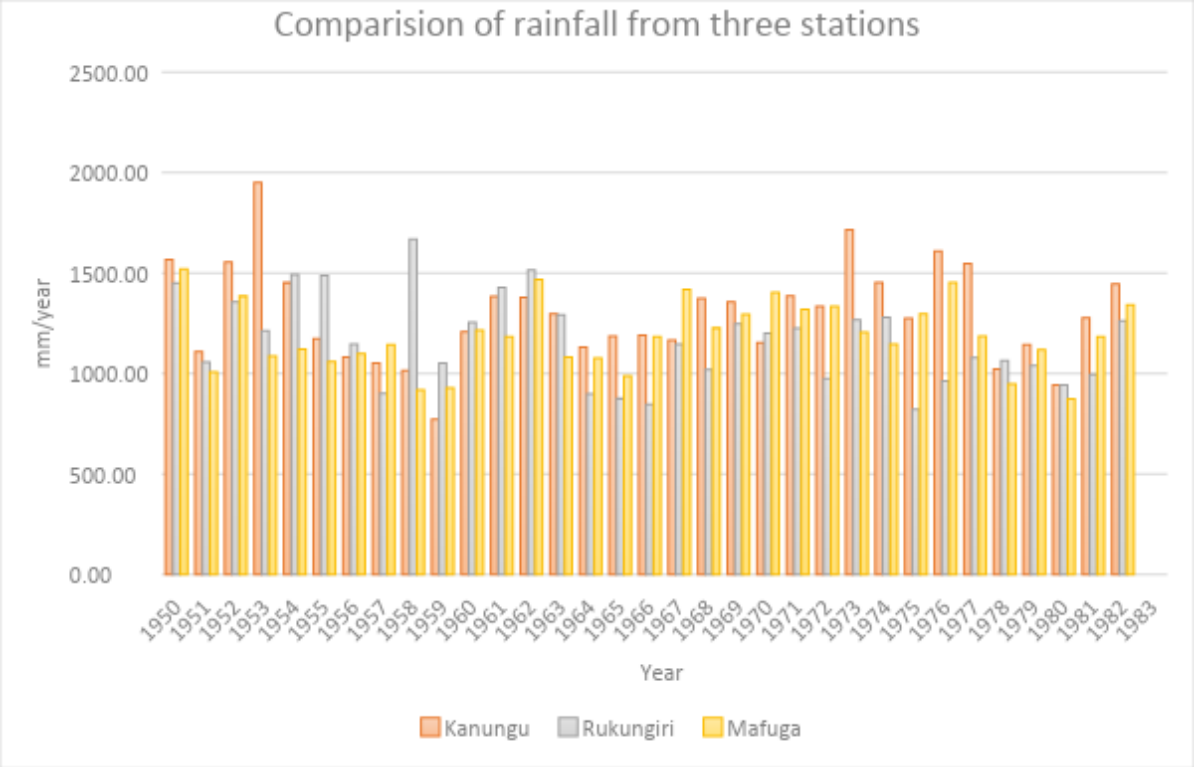


Figure 5-86*: Annual rainfall totals at Kanungu, Rukungiri and Mafuga meteorological stations*

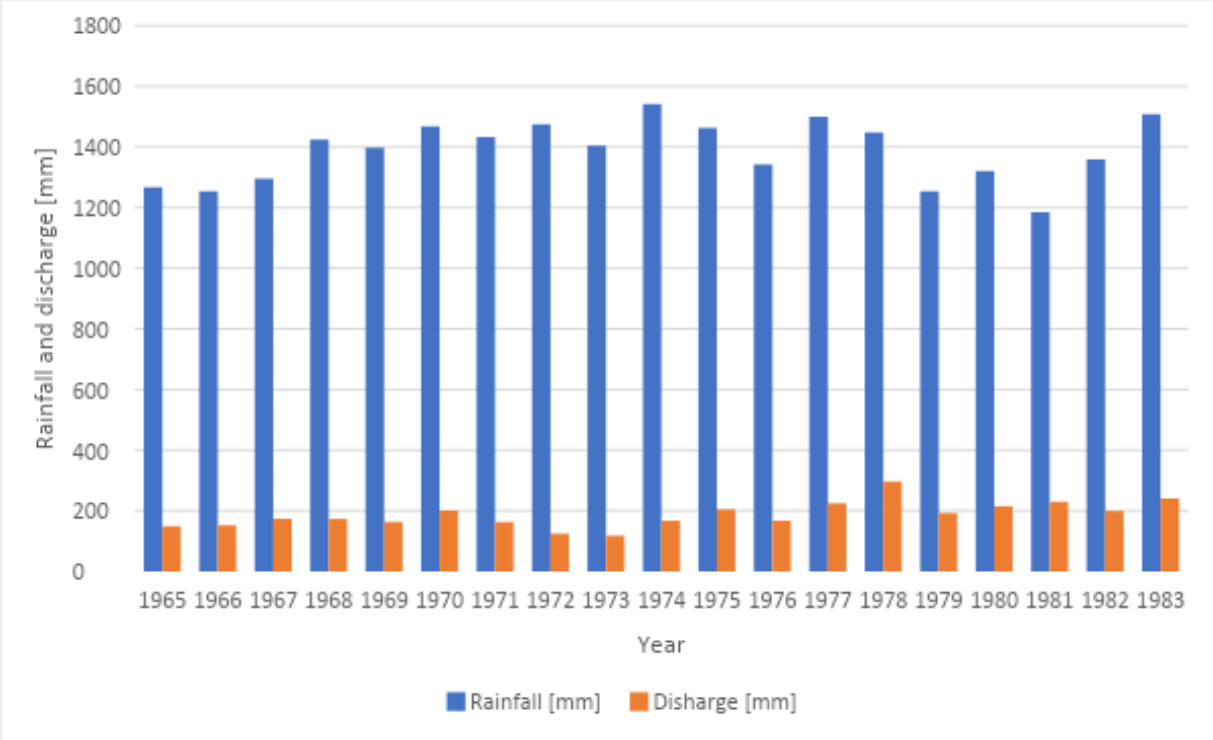


Figure 5-87*: Plot of historical annual rainfall and discharge in mm*

The graph of observed annual discharge against the annual rainfall for historical flows is presented in Figure 5-86 above. The data provides an average runoff coefficient of about 0.14 for the near natural flows. However, it shall be noted that the terrain and time of concentration has a very big influence on the manual records taken only twice daily at a specific time of the day. It is likely that high flows during rainfall events can be easily missed resulting in a lower runoff coefficient. A lot of the rainfall that is received in the catchment is either lost due to evaporation or groundwater recharge. This indicates that the catchment may be very sensitive to changes in the catchment land cover.

Figure 5-88 shows the annual average discharges in meters per second at the dam site, the junction before river Kirunda joins river Kiruruma and the outflow into river Mitano. The average annual discharge of river Mitano is 14.35m^3/s at the hydrological station while that of river Kiruruma is 2.69m^3/s as it joins river Mitano. The flow of Kiruruma is about 19% of the flow of river Mitano. Therefore, it is assumed that the influence of the proposed dam will not be significant after river Kiruruma joins river Mitano.

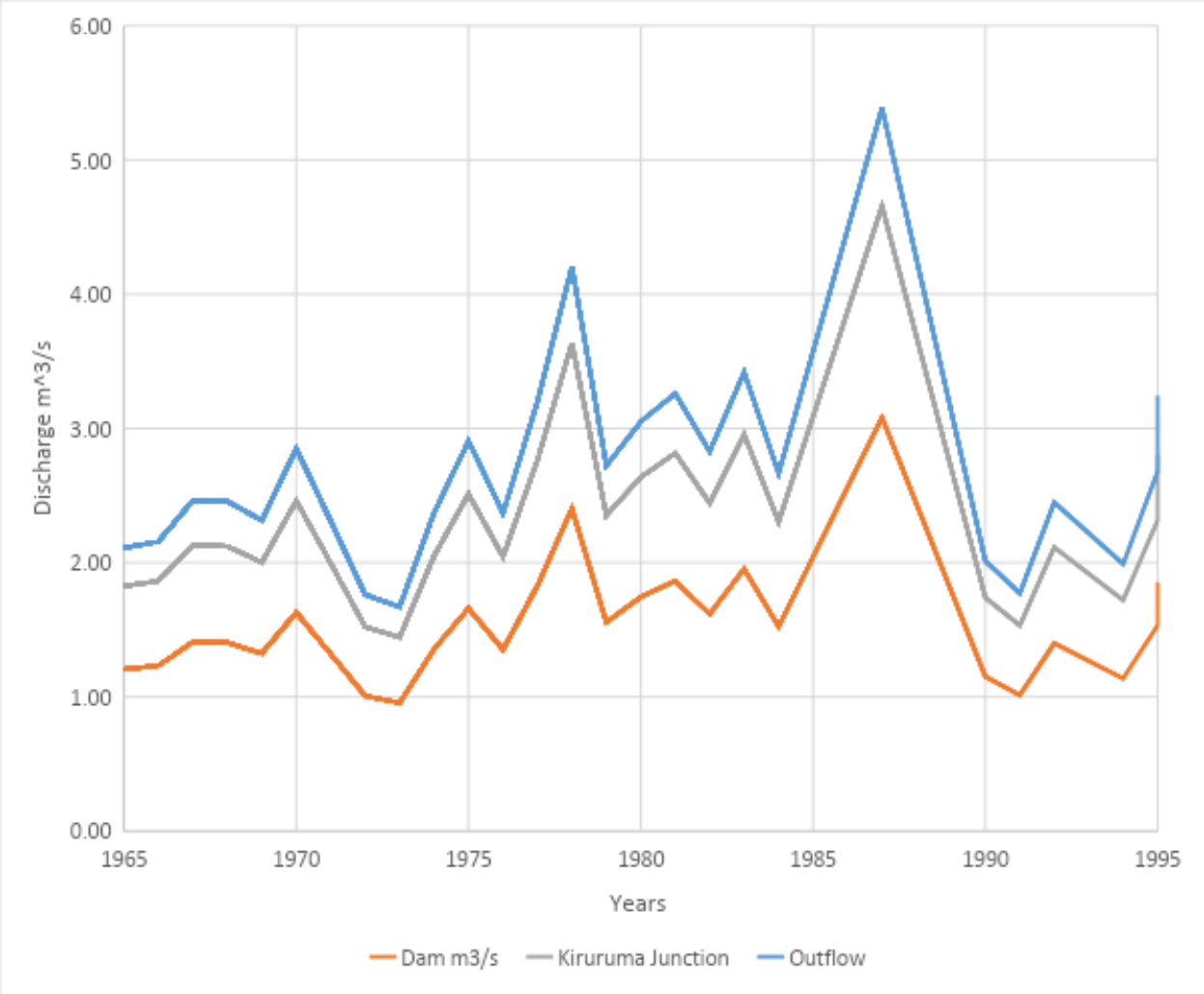


Figure 5-88*: Annual Average discharges in cubic meters per second at selected points*

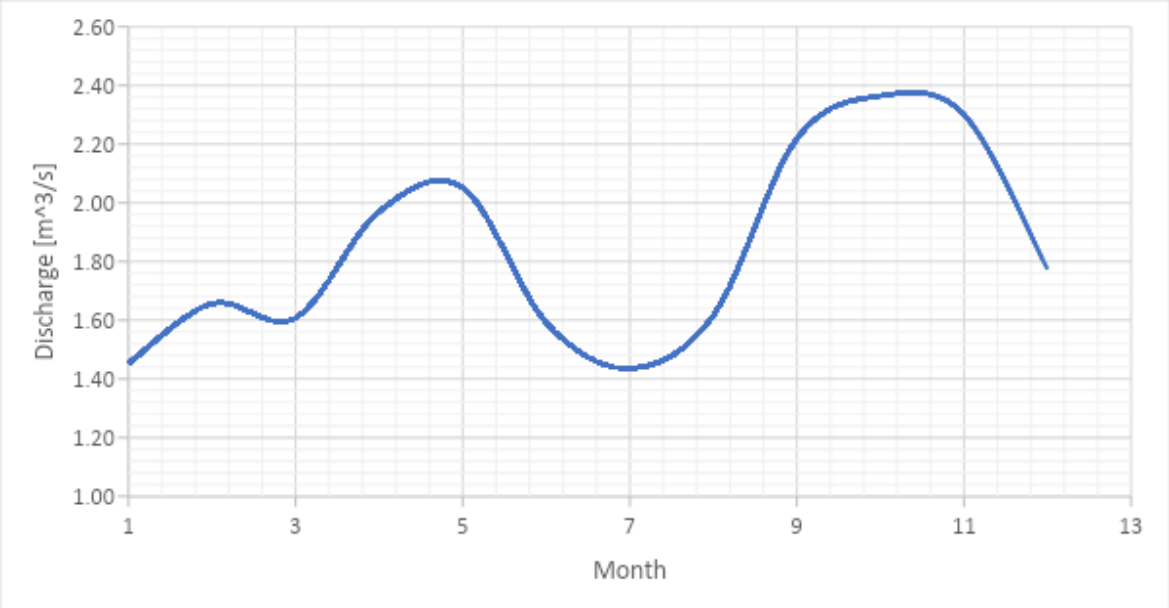


Figure 5-89*: Monthly average flows at R. Kiruruman station in cumecs*

Month	1	2	3	4	5	6	7	8	9	10	11	12
Discharge [m3/s]	1.45	1.66	1.61	1.97	2.05	1.59	1.44	1.62	2.22	2.36	2.30	1.77

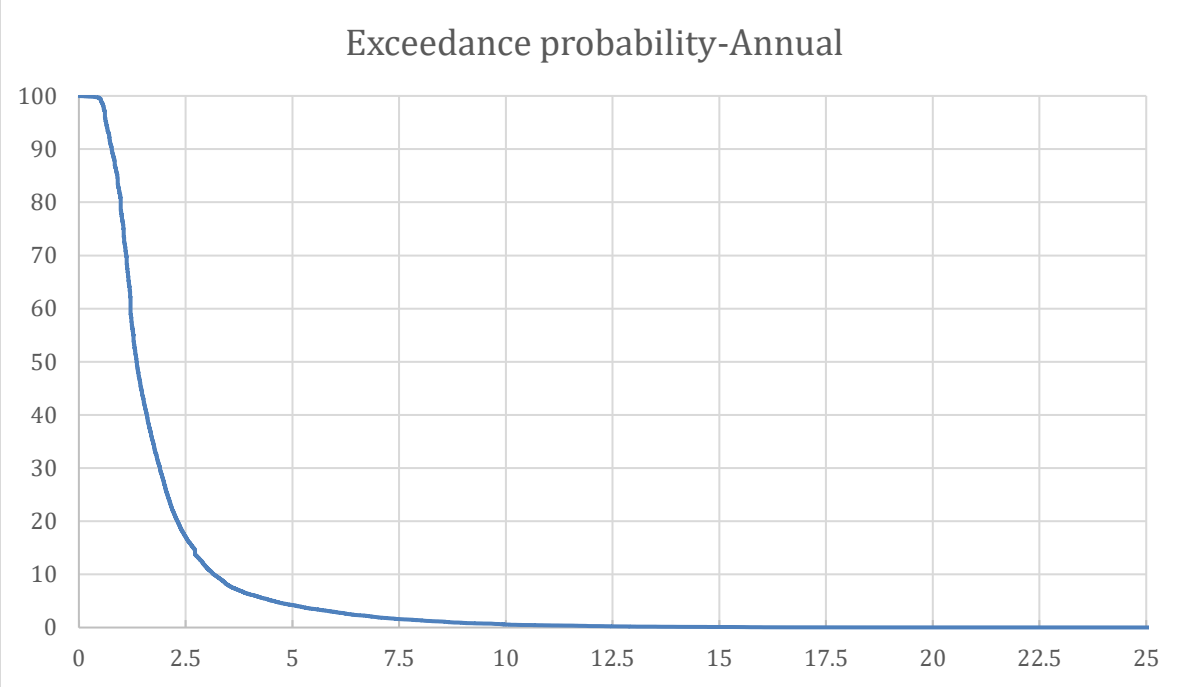
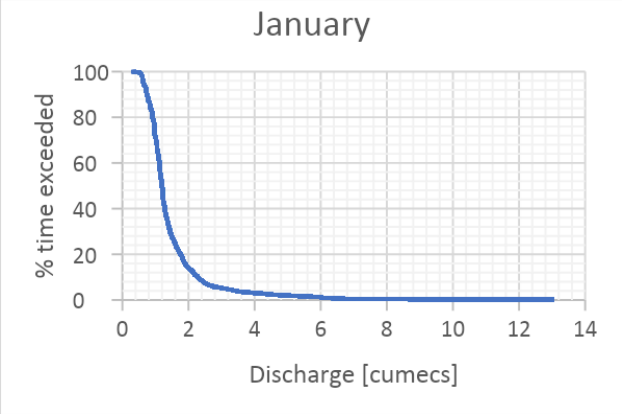
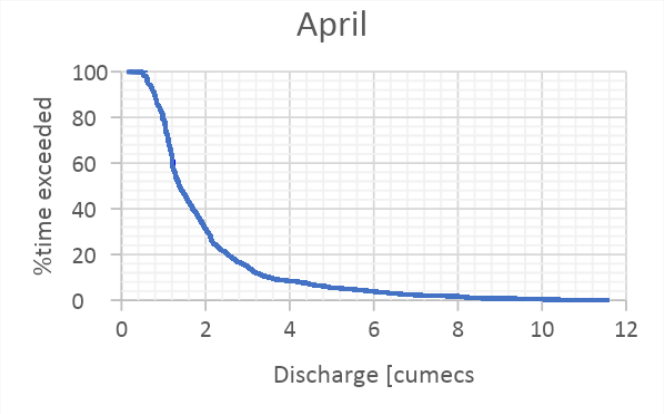
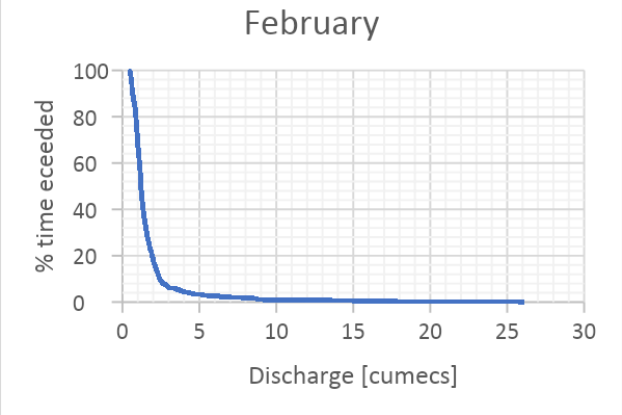


Figure 5-90*: Monthly average flows at R. Kiruruma station in cumecs*


January
% time exceeded
100
80
60
40
20
0
0 2 4 6 8 10 12 14
Discharge [cumecs]


April
%time exceeded
100
80
60
40
20
0
0 2 4 6 8 10 12
Discharge [cumecs


February
% time eceeded
100
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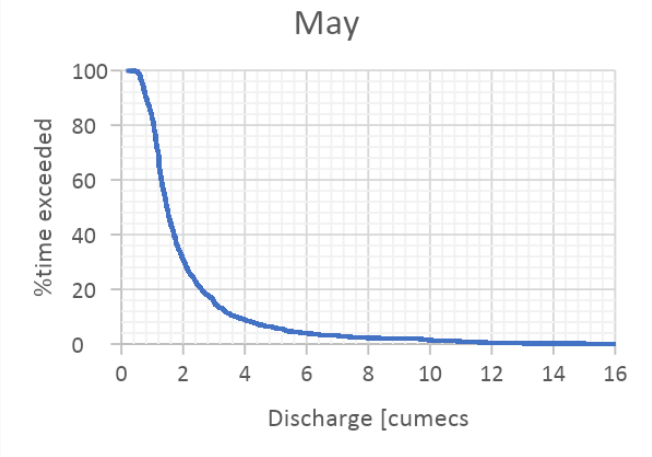
0 5 10 15 20 25 30
Discharge [cumecs]


May
%time exceeded
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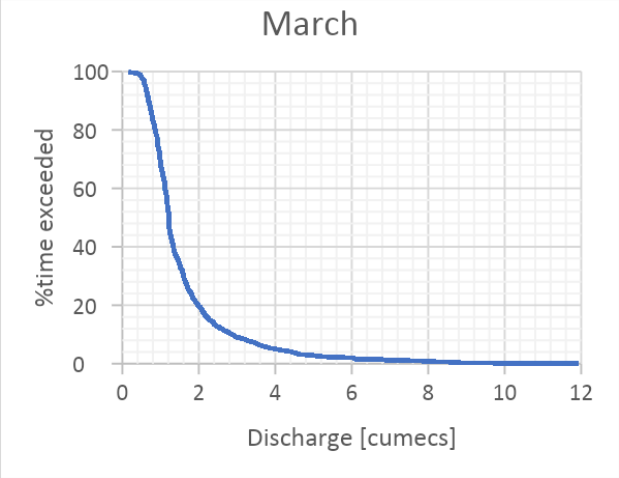
0 2 4 6 8 10 12 14 16
Discharge [cumecs


March
%time exceeded
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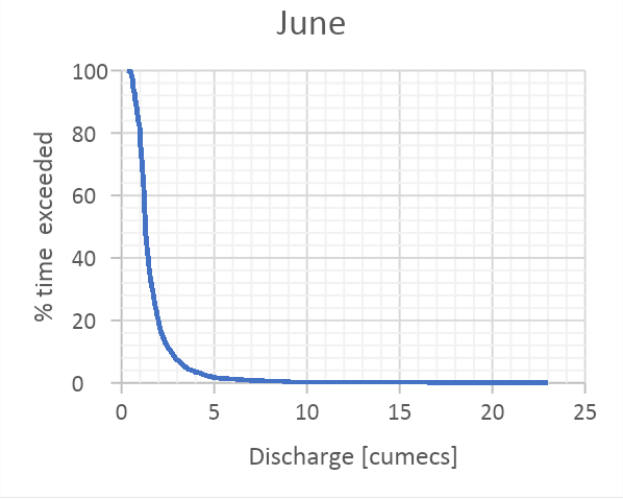
0 2 4 6 8 10 12
Discharge [cumecs]


June
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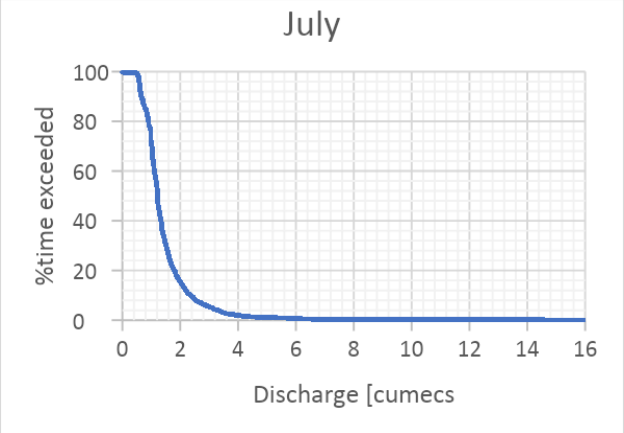
Discharge [cumecs]


July
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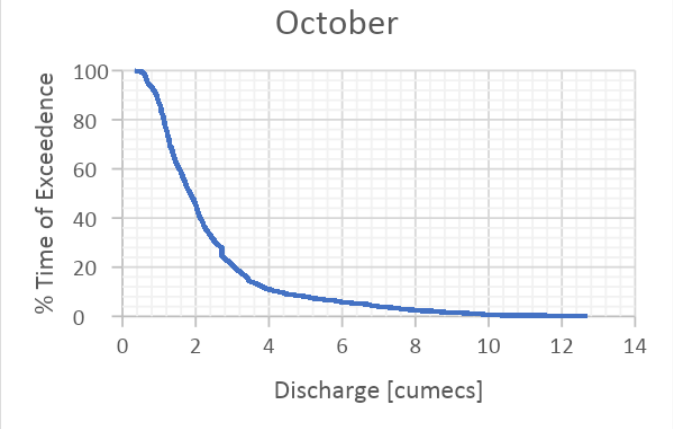
Discharge [cumecs


October
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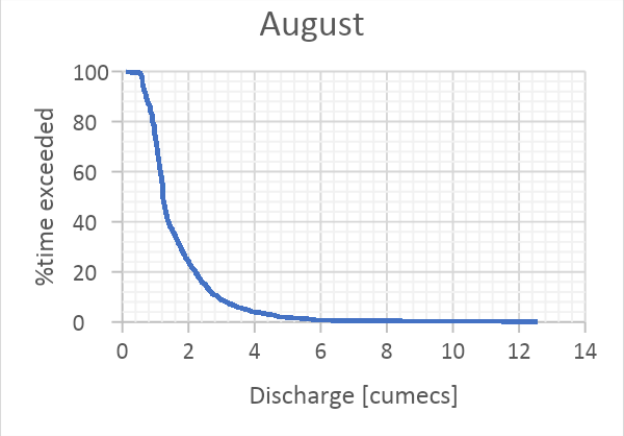
0 2 4 6 8 10 12 14
Discharge [cumecs]


August
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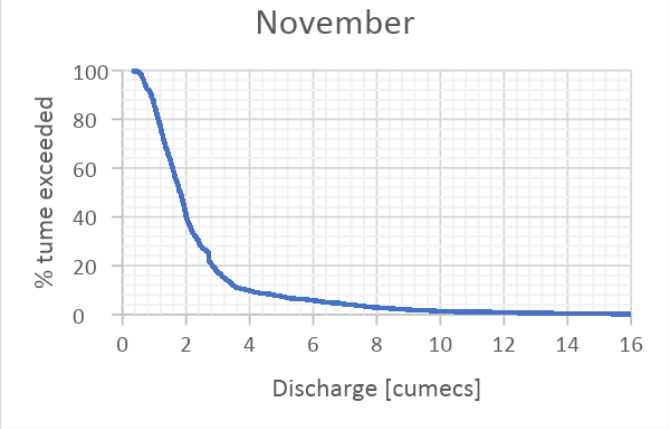
0 2 4 6 8 10 12 14
Discharge [cumecs]


November
% tume exceeded
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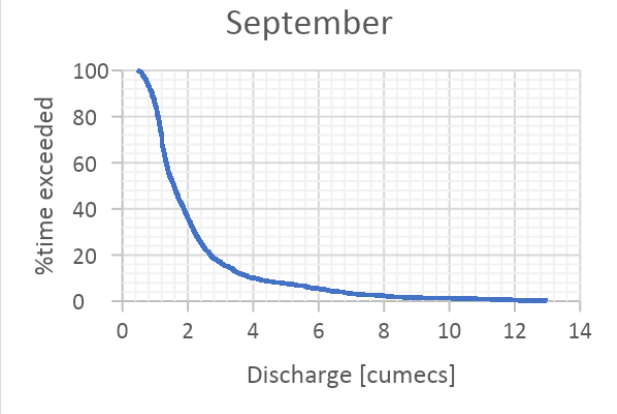
0 2 4 6 8 10 12 14 16
Discharge [cumecs]


September
%time exceeded
100
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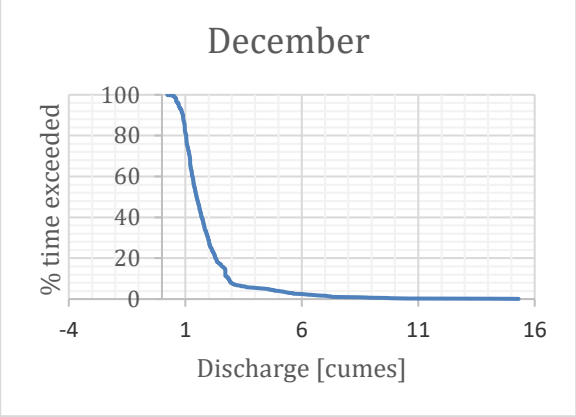
0 2 4 6 8 10 12 14
Discharge [cumecs]


December
% time exceeded
100
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40
20
0
-4 1 6 11 16
Discharge [cumes]

In holistic approaches the central rationale is that different parts of the flow regime elicit different responses from the river ecosystem. Thus, removal of one part of the flow regime will affect the ecosystem differently than removal of another part. Furthermore, it is assumed that:

- It is possible to identify and isolate these different parts of the flow regime within a long-term hydrological data set of daily flows.
- It is possible to describe in isolation the probable biophysical consequences of partial or whole removal of any one of these parts.
- The parts of the flow regime and their linked consequences can be re-combined in various ways, to describe the river condition of any flow regime of interest (the biophysical part of the scenario).
- The social impacts of each river condition can be described (the socio-economic part of the scenario).

The flow is analyzed and differentiated according to the following classification in the Figure 5-42 below.

Table 5-43: Environmental flow components used in holistic approaches.

Flow	Importance to ecosystem
Low Flows	These are the daily flows that occur outside of high-flow peaks. They define the basic hydrological nature of the river: its dry and wet seasons, and degree of perennialism. The different magnitudes of low-flow in the dry and wet seasons create wetted habitat and different hydraulic and water-quality conditions, which directly influence the balance of species at any time of the year.
Small floods /Freshes	Small floods are ecologically important in semi-arid areas in the dry season. They stimulate spawning in fish, flush out poor-quality water, mobilise and sort gravels and cobbles thereby enhancing physical heterogeneity of the riverbed and contribute to flow variability. They re-set a wide spectrum of conditions in the river, triggering and synchronising activities as varied as upstream migrations of fish and germination of riparian seedlings.
Large floods	Large floods trigger many of the same responses as do the small ones, but additionally provide scouring flows that influence the form of the channel. They mobilise coarse sediments, and deposit silt, nutrients, eggs and seeds on floodplains. They inundate backwaters and secondary channels, and trigger bursts of growth in many species. They re-charge soil moisture levels in the banks, inundate floodplains, and scour estuaries thereby maintaining links with the sea.
Flow variability	Fluctuating discharges constantly change conditions through each day and season, creating mosaics of areas inundated and exposed for different lengths of time. The resulting physical heterogeneity determines the local distribution of species: higher physical diversity enhances biodiversity.

Data for river Kiruruma was analyzed for the different flow regimes and the following results were obtained as indicated in Figure 5-90, Table 5-44, and Table 5-45.

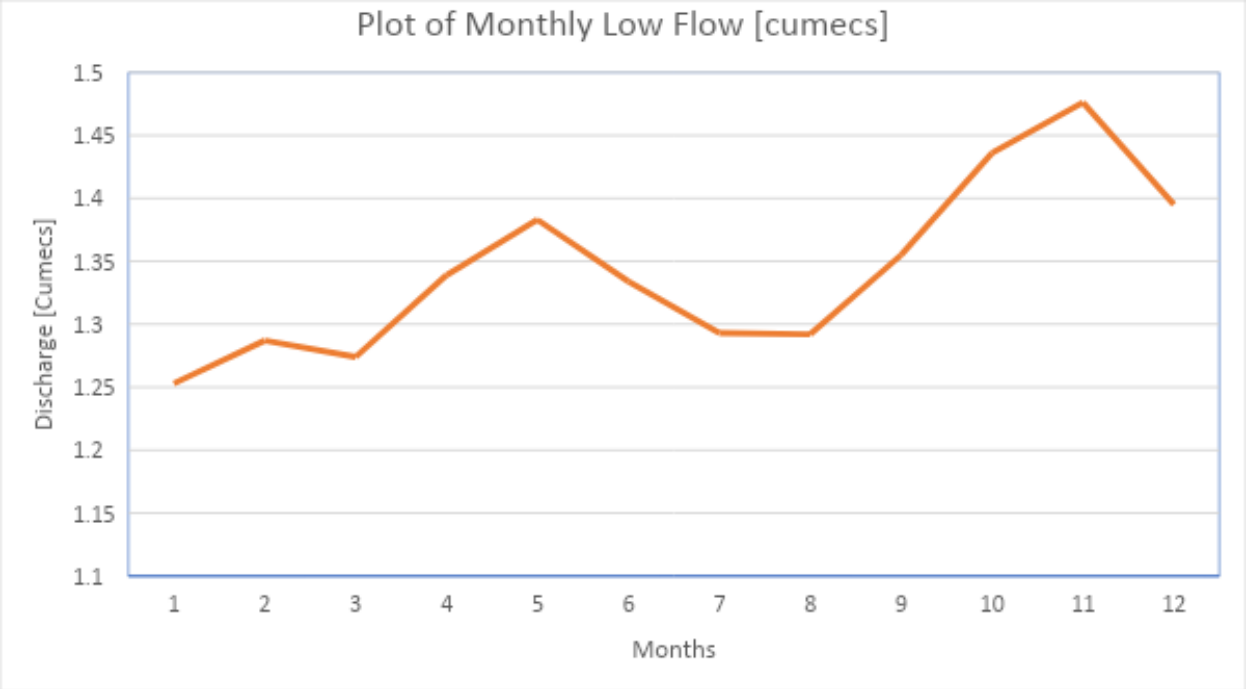

Figure 5-91*: Graph of average natural low flows by month*

Table 5-44: Historical monthly low flows

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Low Flow [cumecs]	1.253	1.287	1.274	1.339	1.383	1.334	1.293	1.292	1.355	1.436	1.476	1.395

Table 5-45 below shows the environmental flow components and characteristics as derived from the flow of river Kiruruma at the gauging station.

Table 5-45: Environmental flow components for Kiruruma river at the gauging station

EFC Parameters	Units	Coefficient of variation
Extreme low peak [cumecs]	0.6241	0.1323
Extreme low duration [days]	3.769	1.025
Extreme low timing [Julian days]	182.4	0.2475
Extreme low freq. [No per yr]	12.12	1.238
High flow peak [cumecs]	3.946	0.2301
High flow duration [days]	3.088	0.7971
High flow timing [Julian days]	294.7	0.3362
High flow frequency [No per yr]	26.62	0.3998
High flow rise rate [Δdisch/day]	1.868	0.3137

EFC Parameters	Units	Coefficient of variation
High flow fall rate [Δdisch/day]	-1.599	-0.3574
Small Flood peak [cumecs]	12.94	0.08946
Small Flood duration [days]	10.39	0.7242
Small Flood timing [Julian days]	289.6	0.2079
Small Flood freq. [No per yr]	0.7941	1.413
Small Flood rise rate [Δdisch/day]	5.688	0.8202
Small Flood fall rate [Δdisch/day]	-4.677	-0.8291
Large flood peak [cumecs]	20.21	0.2604
Large flood duration [days]	13.78	0.5191
Large flood timing [Julian days]	302.6	0.3548
Large flood freq. [No per yr]	0.1471	3.792
Large floods rise rate [Δdisch/day]	3.404	0.2169
Large floods fall rate [Δdisch/day]	-7.191	-0.8092

5.7.4 Sampling river cross-sections and hydraulic modelling

Hydraulic modeling is aimed at developing a series of relationships between discharge and water depth, flow velocity, wetted perimeter, and water surface width among other parameters at selected locations or cross sections. Fluvial geomorphologists and aquatic ecologists use this information to quantify flow requirements for the river by associating these characteristics to the discharge. River reaches can be surveyed in two ways (Jowett et al., 2008): (i) as representative reach (usually for water surface profile modelling or 2D modelling) or (ii) by habitat mapping (stratified sampling). A river need only be divided into multiple reaches if there is a requirement for comparison of hydraulic/habitat characteristics between reaches. It is often convenient to divide the river into multiple reaches where the flow varies, such as upstream and downstream of a tributary stream. This is because during the calibration and analysis of reaches one flow applies to all cross-sections, and it is not necessary to specify the flow at each cross-section (Jowett et al., 2008).

Stratified sampling or habitat mapping was used to represent the physical habitat of the study segment of the river used as a single reach. A stratified sampling shall provide a better representation of available habitat than simple random selection. Using habitat mapping, mesohabitat types with similar hydraulic characteristics were defined and their locations and lengths mapped. The process involved traversing the entire river reach under study to identify the different mesohabitat types. Then cross-sections were chosen to represent each type of mesohabitat in terms of location and proportion to cover the full range of natural variation with a minimum number of cross-sections.

The total number of cross-sections were selected to represent the complexity of the habitat hydraulics to have a robust result. According to King et al., 2008, six to ten cross-sections are sufficient for simple reaches and eighteen to twenty for diverse reaches. Fourteen of cross sections were selected so that no individual

cross-section was given a weight of more than 15% to minimize the influence of outliers. Other considerations in the selection of the cross-section locations included the following:

- accessibility.
- high diversity of physical habitats at the site for aquatic and riparian species, and highly representative of the larger river section.
- flow-sensitive habitat, and critical habitat for important species, even if this is not representative of the whole river section.
- suitable for accurate hydraulic modelling throughout the range of possible flows, and particularly of low flows.
- proximity of a gauging site with good quality hydrological data wherever possible.
- high potential of the site to provide useful EFR information, in terms of its location relative to the proposed water-resource development.
- site positioned upstream rather than downstream of a major tributary.
- good ecological condition, so that clues on flow-related features (such as vertical zonation of riparian vegetation up the banks) to aid understanding of the effects of different flows on the ecosystem.
- proximity to human rural communities that utilise river resources for sustenance, and good representation in terms of the resources used.
- potential as a later monitoring site.

The Figure 5-92 below shows the locations of the selected cross-sections in the selected area of the river under study. The information captured from each section included among others:

- the boundaries of vegetation zone up the banks.
- substratum and other details on physical habitat.
- vegetation and hydraulic cover.
- Cross-section dimensions and details.
- Fixed-point photography.
- Hydraulics: water surface elevation, discharge, and the distribution of water velocities and depths.
- Fluvial geomorphology.
- Hydraulic biotopes across the cross-sections, their hydraulic characteristics, and any features of importance.
- Riparian vegetation placement in the cross-section survey.

The bed particles at each point were assigned to a size class as given in Table 5-39. Particle diameter of gravels and small cobble were measured using calipers and sand and silt size classes were assigned using the field feel methods. One approach to classify stream habitats is to describe a set of biotopes. A biotope is defined as a habitat assemblage with a characteristic range of temporally variable hydraulic and substrate characteristics which can be associated with the morphological units. Therefore, biotopes are a useful classification tool as they can be observed as river surface flow features (flow/hydraulic biotopes) such as riffles and pools, which reflect combinations of sediment, depth and velocity associated with the organization of the riverbed (Baker et al, 2016). Hydraulic biotopes were classified according to water depth, substratum class and flow type. Flow types were classified according toTable 5-37.

Table 5-46: Flow types and their characteristics used in classification of hydraulic biotopes

Flow class	Characteristics
Dry	Substrata out of the water
No flow	No water movement
Barely perceptible flow	Smooth water surface, flow only perceptible through the movement of floating objects
Rippled flow	The water surface has regular disturbances, which form low transverse ripples across the direction of flow.
Surging flow	Strongly rippled flow, with ripples forming undular waves that move downstream.
Unbroken standing waves	Standing waves form at the surface, but there is no broken water
Broken standing waves	Standing waves present which break at the crest (white water)
Chute	Smooth flow, generally over a short distance, with flow acceleration. Often due to flow convergence. Typically occurs in boulder or bedrock channels where flow is being funneled between macro bed elements.
Free falling	Water falls vertically without obstruction
Trickle flow	Very shallow moving water, that cannot be classified according to any of the above criteria.

Table 5-47: Flow type descriptions used to identify the physical biotopes found in the field: adopted from Baker et al., 2016.

Associated biotope	Flow type	Description
Run	Chute	Surface turbulence does not produce waves, but symmetrical ripples that move in a general downstream direction.
Pool	Scarcely perceptible flow	Surface foam appears to be stationery and reflections are not distorted; a stick placed on the water's surface will remain still.
Riffle	Unbroken standing waves	Undular standing waves in which the crests face upstream without breaking.

The classification provided below in Table 5-48 was used to classify the type of riverbed found at each selected sampling section.

Table 5-48: Classification of riverbeds

Class	Type	Character
Non-cohesive	Sand	Composed largely of sand-sized material (this size is transported over a large range of discharges and called “mobile” or “live” bed)
	Gravel	Composed of gravel or small cobble material transported at high discharges
	Boulder	Composed of large cobbles and boulders that are moved by infrequent large flows.
Cohesive	Silt/Clay	Composed mainly of silt and clay with degree of cohesiveness related to the amount of clay
	Bedrock	Composed of no unconsolidated material

Conversion of the summary hydrological statistics to information on local hydraulic conditions is the vital link that allows river scientists to understand why river features and species occur where they do. Graphics of each cross-section are marked to show the extent of each vertical zone of riparian vegetation, as well as any other features of interest, such as riffles, secondary channels, sand, or aquatic vegetation. The range of inundated areas in the two low-flow seasons, and the levels reached by each size class of flood, are also shown. These graphics, together with the hydraulic modelling outputs of velocities and depths, the low-flow FDCs, and data on the frequency and timing of different size classes of floods, allow the specialists to develop an understanding of the links between flow and the features or species of interest to them.

A. Results of hydraulic modelling and cross section sampling

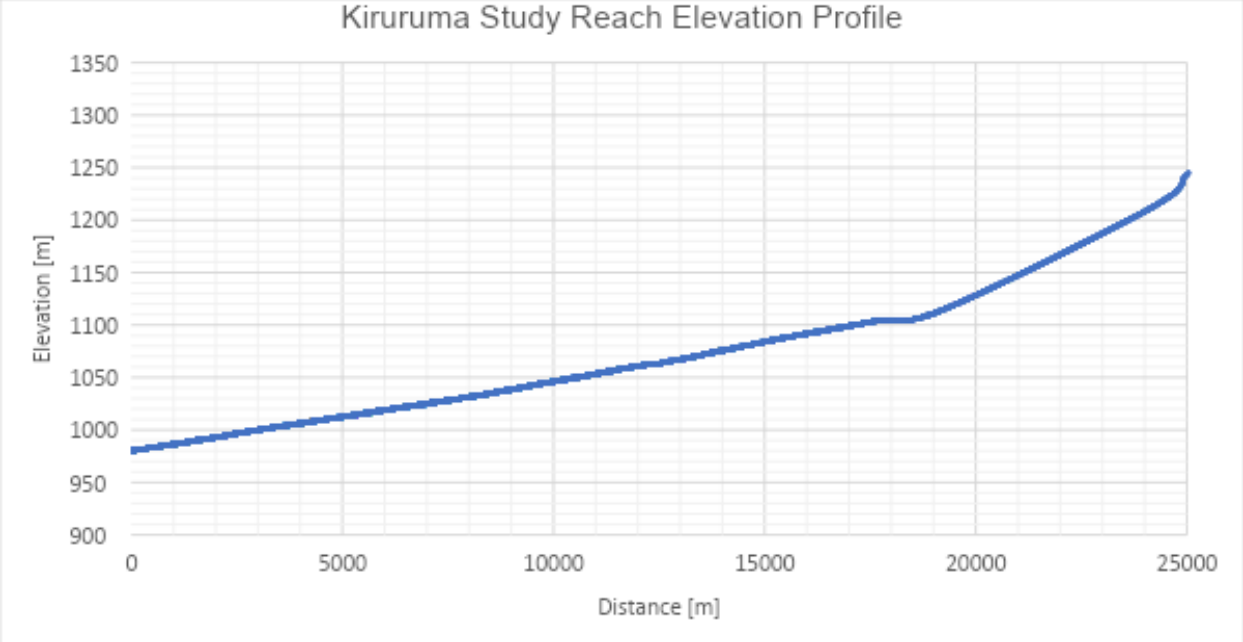

Figure 5-92*: Elevation profile of the reach on Kiruruma river that was studied.*

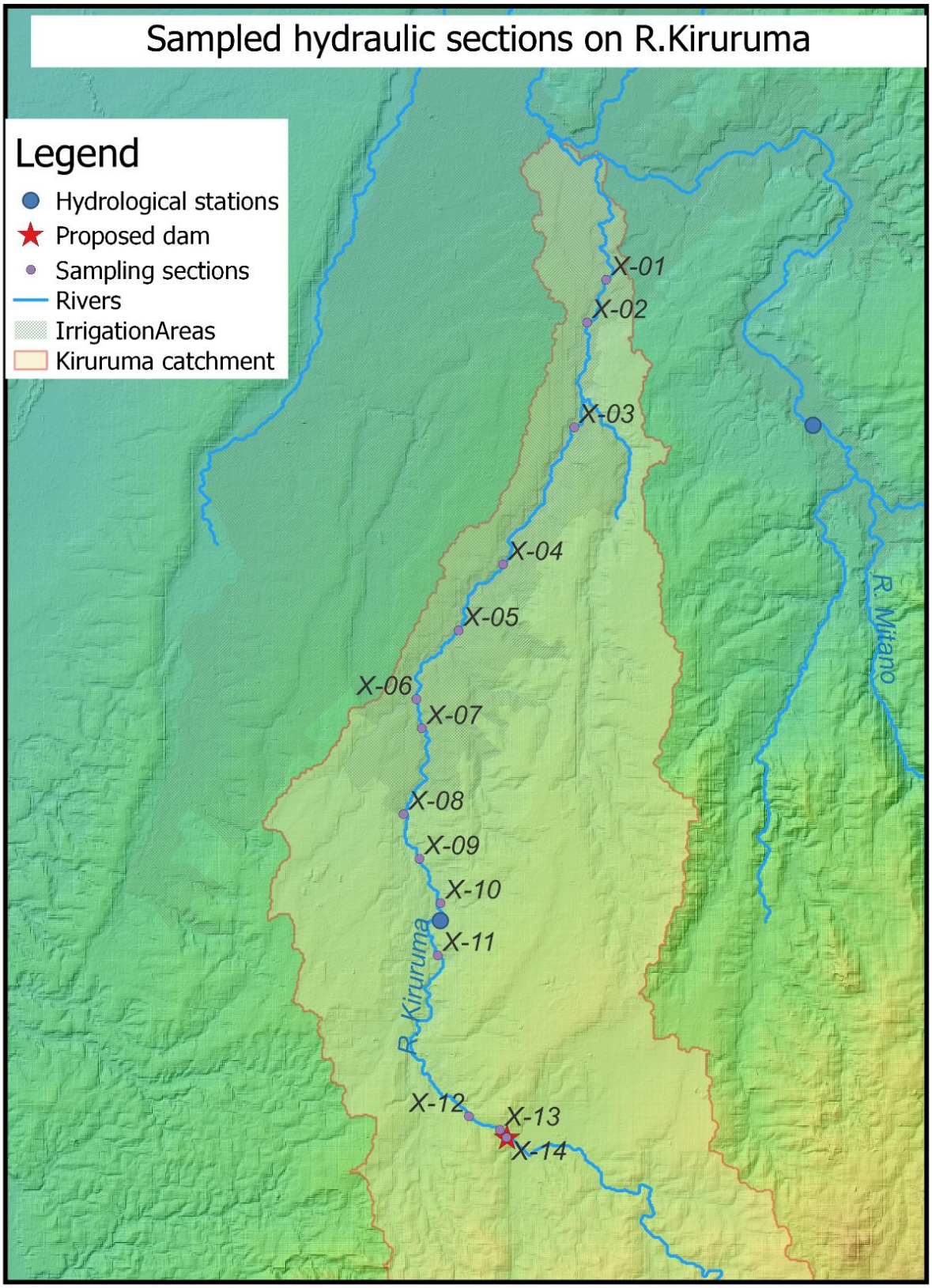

Figure 5-93: Sampling points where hydraulic sections were taken.

Table 5-49: Summary information about each selected cross section.

H-Sections	Distances [m]	% Contribution	Bottom Elevation [m]	Local Slope [m/m]	Substrate	Hydraulic biotopes
X-14	222	1%	1245.18	0.0553	Silt/clay	Run
X-13	795	2%	1241.55	0.3484	Rock	Riffle
X-12	4906	11%	1211.78	0.1425	Rock	Riffle
X-11	1614	13%	1114.96	0.0138	Silt/clay	Run
X-10	1184	5%	1103.78	0.0030	Silt/clay	Run
X-09	1296	5%	1095.02	0.0018	Cobbles/sand	Run
X-08	2428	7%	1085.41	0.0040	Silt/clay	Run
X-07	732	6%	1065.08	0.0138	Silt/clay	Run
X-06	2300	6%	1060.78	0.0047	Silt/clay	Run
X-05	2046	8%	1043.78	0.0397	Silt/clay	Run
X-04	3820	11%	1029.16	0.0231	Silt/clay	Run
X-03	2649	12%	1005.2	0.0068	Silt/clay	Run
X-02	1183	7%	987.53	0.0032	Silt/clay	Run
X-01	0	5%	980.27	0.0057	Cobles/sand	Run

Table 5-50: Results of hydraulic modeling for the various cross-sections

Section	Discharge[m3/s]	Depth[m]	Velocity [m/s]	Flow Area [m^2]	Top Width[m]	Froude No.
14	0.62	0.22	1.12	0.55	4.34	1.01
14	1.29	0.35	1.15	1.12	4.81	0.76
14	1.95	0.41	1.36	1.44	4.97	0.81
14	2.62	0.47	1.53	1.71	5.37	0.85
14	3.28	0.51	1.68	1.96	5.57	0.88
14	3.95	0.55	1.81	2.21	5.7	0.90
14	6.19	0.67	2.21	2.86	6.02	0.99
14	8.44	0.79	2.41	3.6	6.37	0.99
14	12.94	0.99	2.71	4.94	6.96	0.99
14	16.58	1.13	2.89	5.97	7.37	0.99
14	20.21	1.26	3.05	6.93	7.75	0.99
13	0.62	0.29	1.08	0.58	4.89	1.00
13	1.29	0.36	1.33	0.97	5.65	1.02
13	1.95	0.42	1.5	1.3	5.91	1.02
13	2.62	0.47	1.63	1.61	6.14	1.01
13	3.28	0.52	1.73	1.89	6.34	1.01
13	3.95	0.56	1.83	2.16	6.53	1.02

Section	Discharge[m3/s]	Depth[m]	Velocity [m/s]	Flow Area [m^2]	Top Width[m]	Froude No.
13	6.19	0.69	1.99	3.2	8.53	0.96
13	8.44	0.79	2.17	4.06	8.98	0.97
13	12.94	0.95	2.44	5.57	9.71	0.98
13	16.58	1.07	2.6	6.73	10.24	0.98
13	20.21	1.16	2.75	7.75	10.68	0.99
12	0.62	0.25	1.12	0.55	4.54	1.03
12	1.29	0.34	1.33	0.97	5.36	1.00
12	1.95	0.4	1.51	1.29	5.75	1.02
12	2.62	0.46	1.54	1.7	7.37	1.02
12	3.28	0.5	1.65	1.99	7.47	1.02
12	3.95	0.53	1.74	2.27	7.55	1.02
12	6.19	0.66	1.84	3.65	11.97	0.90
12	8.44	0.74	2.01	4.65	12.05	0.90
12	12.94	0.87	2.34	6.18	12.16	0.94
12	16.58	0.97	2.52	7.34	12.25	0.95
12	20.21	1.05	2.7	8.34	12.32	0.97
11	0.62	0.38	0.46	1.35	8.16	0.36
11	1.29	0.47	0.59	2.18	9.44	0.39
11	1.95	0.54	0.69	2.86	11.64	0.40
11	2.62	0.58	0.81	3.31	11.67	0.45
11	3.28	0.62	0.89	3.83	11.7	0.46
11	3.95	0.61	1.11	3.69	11.69	0.58
11	6.19	0.78	1.13	5.73	11.83	0.49
11	8.44	0.88	1.28	6.94	11.9	0.51
11	12.94	1.03	1.57	8.69	12.23	0.57
11	16.58	1.03	2.02	8.67	12.22	0.73
11	20.21	1.14	2.12	10.1	12.59	0.71
10	0.62	0.29	0.92	0.67	6.4	0.91
10	1.29	0.35	1.2	1.07	6.45	0.94
10	1.95	0.4	1.39	1.4	6.49	0.96
10	2.62	0.47	1.4	1.88	7.14	0.83
10	3.28	0.52	1.51	2.23	8.14	0.83
10	3.95	0.63	1.32	3.17	8.62	0.63
10	6.19	0.67	1.87	3.52	8.79	0.86
10	8.44	0.77	2.07	4.4	9.2	0.87
10	12.94	0.97	2.25	6.69	15.25	0.81
10	16.58	1.18	2.02	12.17	36.13	0.65
10	20.21	1.24	2.17	14.1	36.37	0.68
9	0.62	0.34	0.54	1.14	6.03	0.40
9	1.29	0.45	0.69	1.86	6.88	0.43
9	1.95	0.52	0.81	2.4	7	0.44
9	2.62	0.57	0.96	2.75	7.82	0.49
9	3.28	0.62	1.05	3.18	8.2	0.51
9	3.95	0.6	1.33	3.01	8.05	0.66
9	6.19	0.81	1.35	4.85	10.04	0.55
9	8.44	0.92	1.53	6.1	12.85	0.57
9	12.94	1.06	1.88	8.12	15.66	0.64
9	16.58	1.05	2.46	7.89	15.47	0.85
9	20.21	1.16	2.5	10.11	26.49	0.81

Section	Discharge[m3/s]	Depth[m]	Velocity [m/s]	Flow Area [m^2]	Top Width[m]	Froude No.
8	0.62	0.18	0.99	0.63	6.53	1.02
8	1.29	0.24	1.25	1.04	6.7	1.01
8	1.95	0.29	1.43	1.36	6.76	1.02
8	2.62	0.36	1.42	1.84	6.85	0.87
8	3.28	0.41	1.53	2.15	6.9	0.87
8	3.95	0.53	1.31	3.11	9.84	0.64
8	6.19	0.56	1.9	3.42	9.98	0.90
8	8.44	0.65	2.1	4.34	10.35	0.91
8	12.94	0.84	2.25	6.68	21.23	0.84
8	16.58	1.04	1.88	13.57	59.98	0.62
8	20.21	1.1	1.95	18.1	71.47	0.62
7	0.62	0.46	0.51	1.21	5.41	0.35
7	1.29	0.52	0.82	1.57	6	0.51
7	1.95	0.59	0.97	2.01	6.07	0.54
7	2.62	0.67	1.06	2.48	6.14	0.53
7	3.28	0.73	1.15	2.84	6.2	0.54
7	3.95	0.7	1.48	2.66	6.17	0.72
7	6.19	0.93	1.47	4.45	9.49	0.58
7	8.44	1.04	1.66	5.72	17.02	0.60
7	12.94	1.2	1.87	10.35	49.59	0.62
7	16.58	1.27	1.93	14.67	63.48	0.62
7	20.21	1.35	1.92	20.03	75.84	0.59
6	0.62	0.32	1.12	0.55	4.51	1.03
6	1.29	0.49	0.86	1.5	6.09	0.56
6	1.95	0.57	0.99	1.97	6.25	0.56
6	2.62	0.62	1.14	2.31	6.37	0.60
6	3.28	0.68	1.23	2.68	7.1	0.61
6	3.95	0.8	1.12	3.72	9.48	0.49
6	6.19	0.87	1.55	4.35	11.19	0.64
6	8.44	0.97	1.71	6.11	21.27	0.65
6	12.94	1.11	1.91	9.87	32.57	0.66
6	16.58	1.18	2.07	12.44	38.41	0.69
6	20.21	1.24	2.25	14.49	42.5	0.73
5	0.62	0.33	0.53	1.17	6.49	0.40
5	1.29	0.37	0.91	1.42	6.55	0.63
5	1.95	0.43	1.08	1.81	6.64	0.66
5	2.62	0.49	1.18	2.23	6.74	0.65
5	3.28	0.53	1.29	2.54	6.81	0.67
5	3.95	0.48	1.8	2.19	6.73	1.01
5	6.19	0.7	1.68	3.73	7.55	0.73
5	8.44	0.8	1.91	4.54	8.01	0.76
5	12.94	0.97	2.24	6.53	18.84	0.79
5	16.58	1.13	2.19	10.26	33.23	0.71
5	20.21	1.2	2.32	13	40.61	0.73
4	0.62	0.28	1.25	0.5	3.24	1.02
4	1.29	0.51	0.97	1.33	3.99	0.53
4	1.95	0.62	1.1	1.77	4.2	0.54
4	2.62	0.71	1.2	2.18	4.7	0.56

Section	Discharge[m3/s]	Depth[m]	Velocity [m/s]	Flow Area [m^2]	Top Width[m]	Froude No.
4	3.28	0.79	1.29	2.55	4.78	0.56
4	3.95	0.86	1.36	2.9	4.87	0.56
4	6.19	1.05	1.54	4.51	12.21	0.58
4	8.44	1.16	1.69	5.98	13.29	0.59
4	12.94	1.33	1.9	9.01	23.34	0.60
4	16.58	1.43	2.02	11.62	27.82	0.61
4	20.21	1.53	2.14	15.12	38.13	0.62
3	0.62	0.23	0.72	0.86	5.07	0.56
3	1.29	0.33	0.94	1.37	5.23	0.59
3	1.95	0.41	1.1	1.77	5.36	0.61
3	2.62	0.54	0.9	2.95	12.65	0.57
3	3.28	0.58	0.99	3.37	12.89	0.60
3	3.95	0.61	1.07	3.78	13.11	0.61
3	6.19	0.7	1.29	4.97	13.74	0.65
3	8.44	0.77	1.46	6.06	14.29	0.67
3	12.94	0.9	1.73	7.99	15.22	0.70
3	16.58	1	1.9	9.43	16.48	0.72
3	20.21	1.08	2.05	10.8	17.3	0.74
2	0.62	0.28	0.78	0.79	3.77	0.55
2	1.29	0.44	0.81	1.59	7.33	0.55
2	1.95	0.51	0.94	2.07	7.51	0.57
2	2.62	0.56	1.06	2.48	7.66	0.59
2	3.28	0.62	1.13	2.95	11.31	0.60
2	3.95	0.66	1.21	3.49	13.99	0.60
2	6.19	0.76	1.4	5.1	15.77	0.62
2	8.44	0.85	1.55	6.5	16.79	0.64
2	12.94	0.99	1.77	8.99	18.45	0.66
2	16.58	1.09	1.91	10.77	18.98	0.67
2	20.21	1.17	2.03	12.41	19.45	0.68
1	0.62	0.45	0.68	0.91	4.58	0.49
1	1.29	0.57	0.84	1.53	5.36	0.51
1	1.95	0.67	0.92	2.12	6.53	0.52
1	2.62	0.74	1.02	2.57	6.68	0.53
1	3.28	0.81	1.07	3.07	7.53	0.53
1	3.95	0.86	1.13	3.48	7.81	0.54
1	6.19	1.01	1.32	4.74	10.01	0.56
1	8.44	1.12	1.49	5.93	12	0.58
1	12.94	1.29	1.74	8.19	13.62	0.60
1	16.58	1.41	1.89	9.83	14.37	0.62
1	20.21	1.51	2.03	11.36	15.07	0.63

Cross-Section One

Table 5-51: Measured discharge details for Cross-Section One

Width (m)	7.356
Area (m2)	4.416
Mean Speed (m/s)	0.832
Total Q (m3/s)	3.640
Mean Depth	0.51
Maximum Depth	0.96

Figure 5-94: Cross Section one Profile

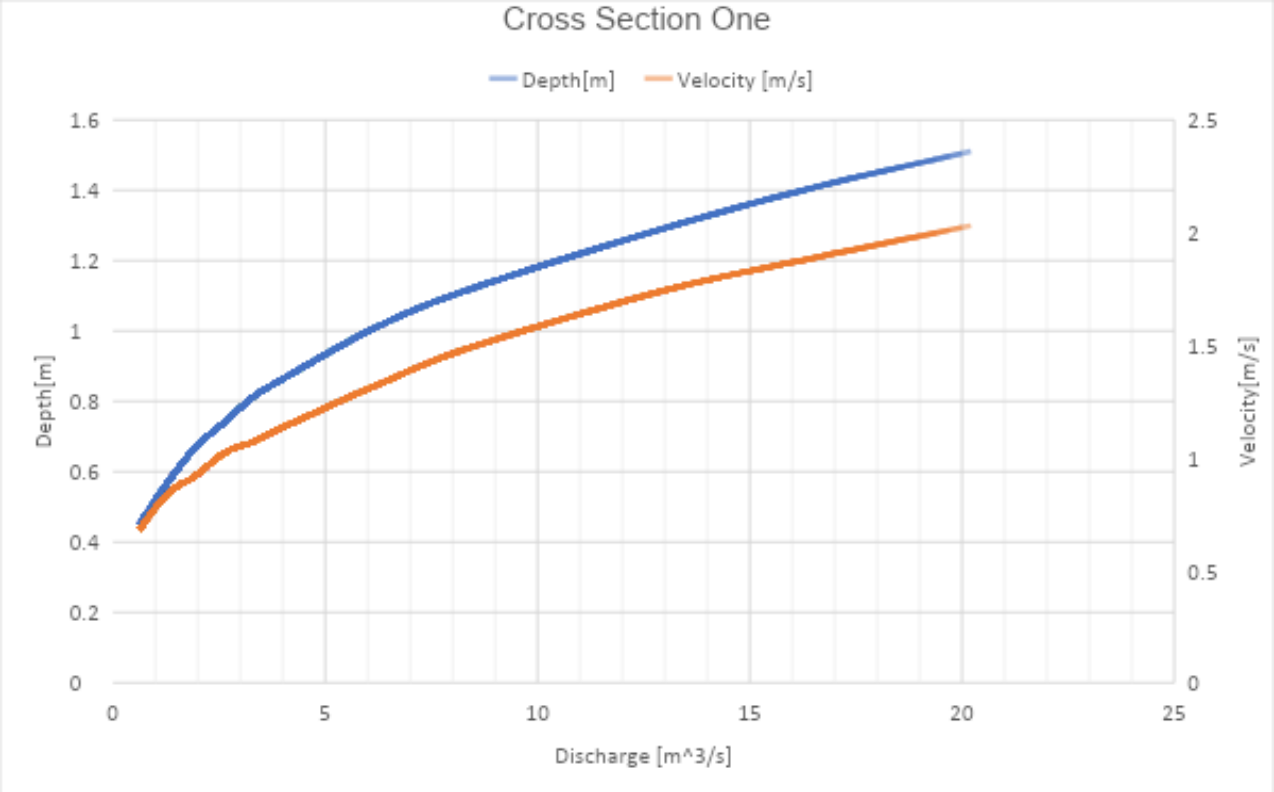

Figure 5-95: Cross Section one Discharge

Photo 5-34 Cross Section one field visit

Cross Section Two

Table 5-52: Measured discharge details for Cross-Section Two

Width (m)	8.691
Area (m2)	3.616
Mean Speed (m/s)	0.432
Total Q (m3/s)	1.526
Mean Depth	0.44
Maximum Depth(m)	0.63

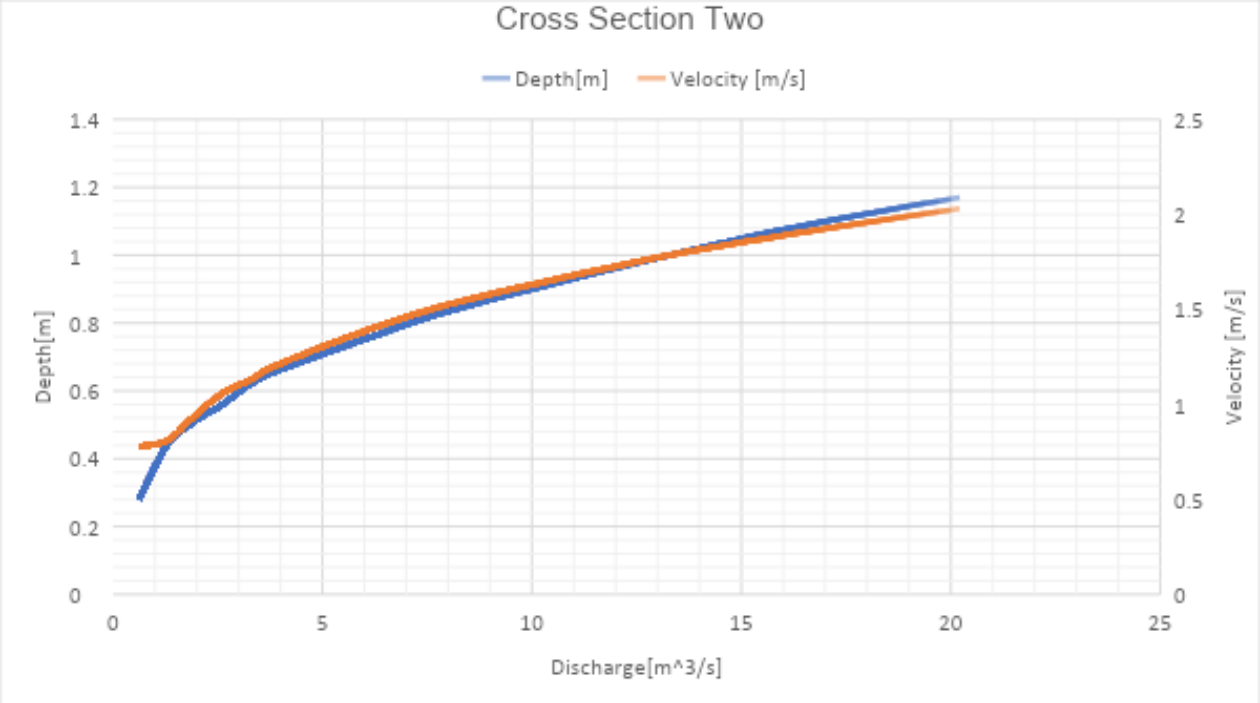

Figure 5-96: Cross Section Two Discharge

Photo 5-35: Cross Section Two field visit

Cross Section Three

Table 5-53: Measured discharge details for Cross-Section Three

Width (m)	8.822
Area (m2)	2.935
Mean Speed (m/s)	0.674
Total Q (m3/s)	1.825
Mean Depth	0.37
Maximum Depth	0.49

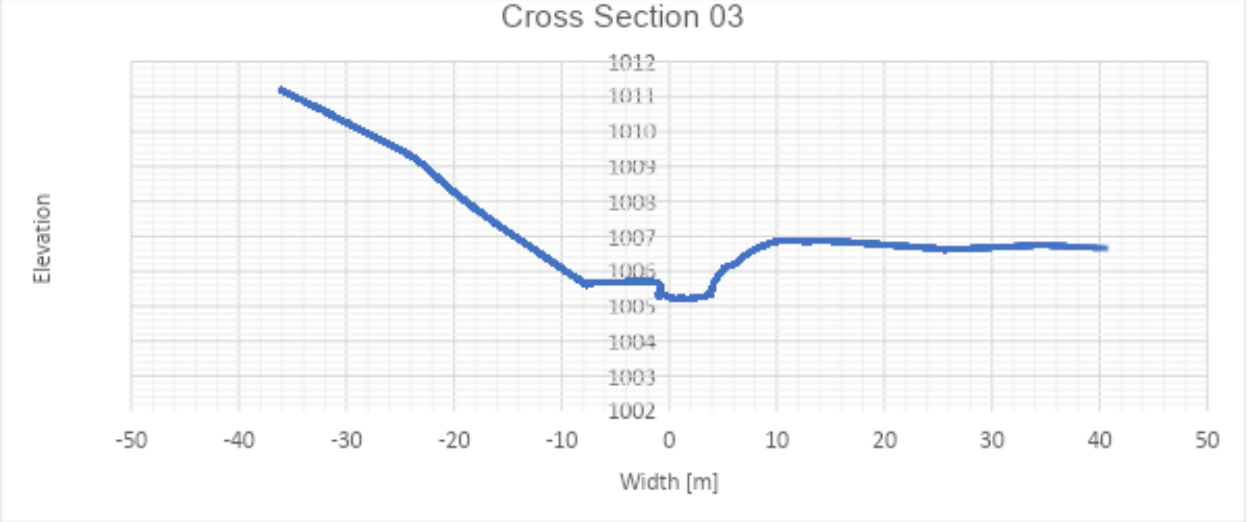

Table 5-54: Cross Section Three Profile

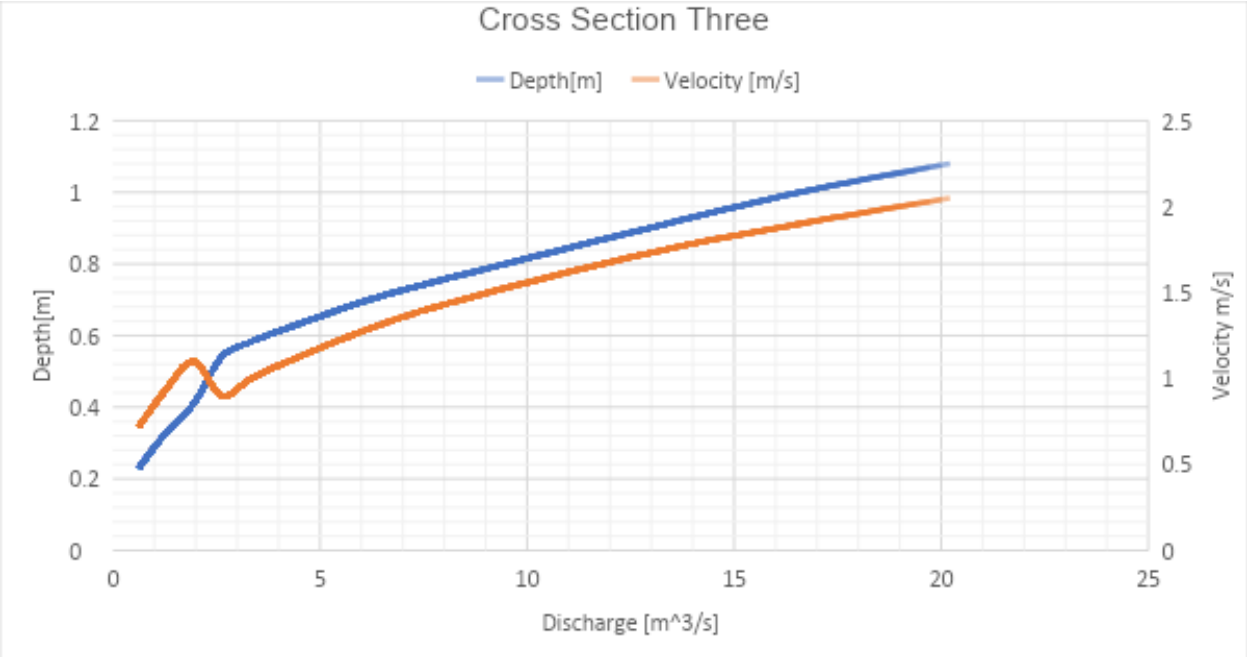

Figure 5-97 Cross Section Three Discharge

Photo 5-36 Cross Section Three field visit

Cross Section Four

Table 5-55: Measured discharge details for Cross-Section Four

Width (m)	5.974
Area (m2)	4.045
Mean Speed (m/s)	0.524
Total Q (m3/s)	2.119
Mean Depth	1.49
Maximum Depth	0.92

Figure 5-98: Cross Section Four Profile

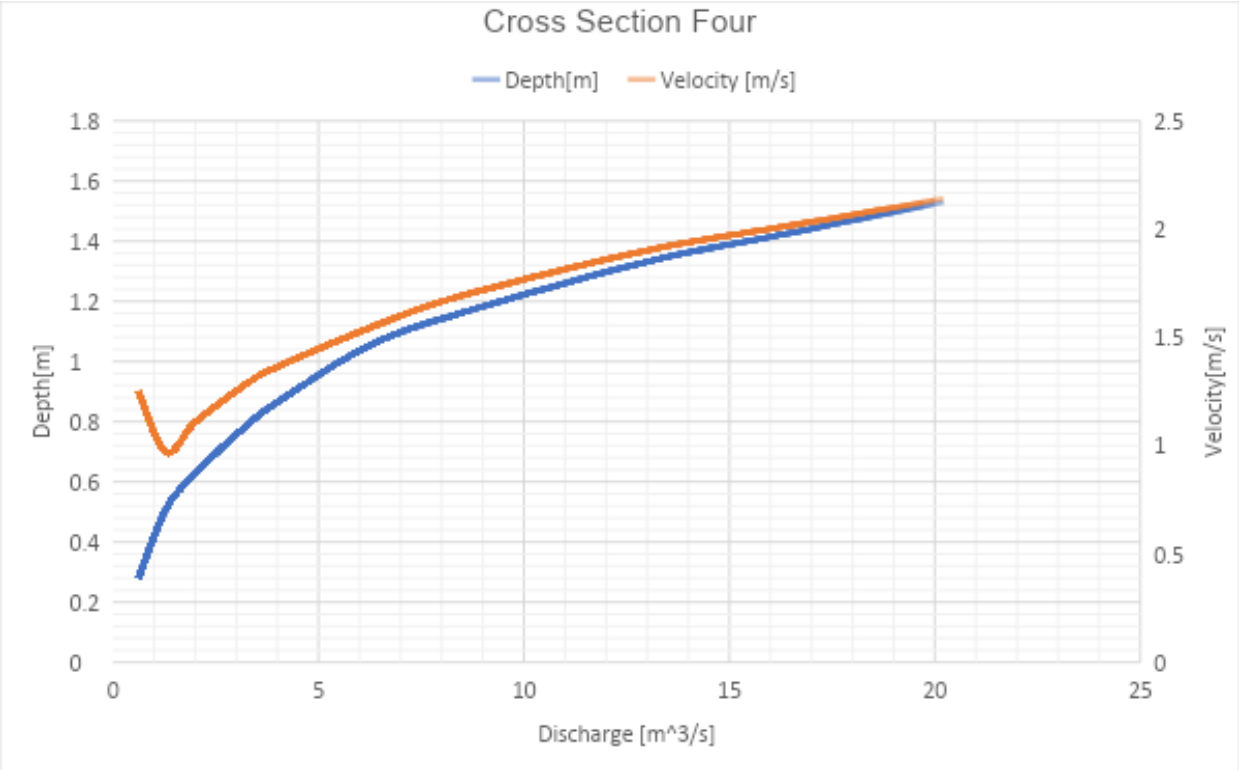

Figure 5-99: Cross Section Four Discharge

Photo 5-37: Cross Section Four field visit

Cross section Five

Table 5-56: Measured discharge details for Cross-Section Five

Width (m)	6.79
Area (m2)	2.43
Mean Speed (m/s)	0.410
Total Q (m3/s)	0.962
Mean Depth (m)	0.35
Maximum Depth (m)	0.55

Figure 5-100: Cross Section Five Profile

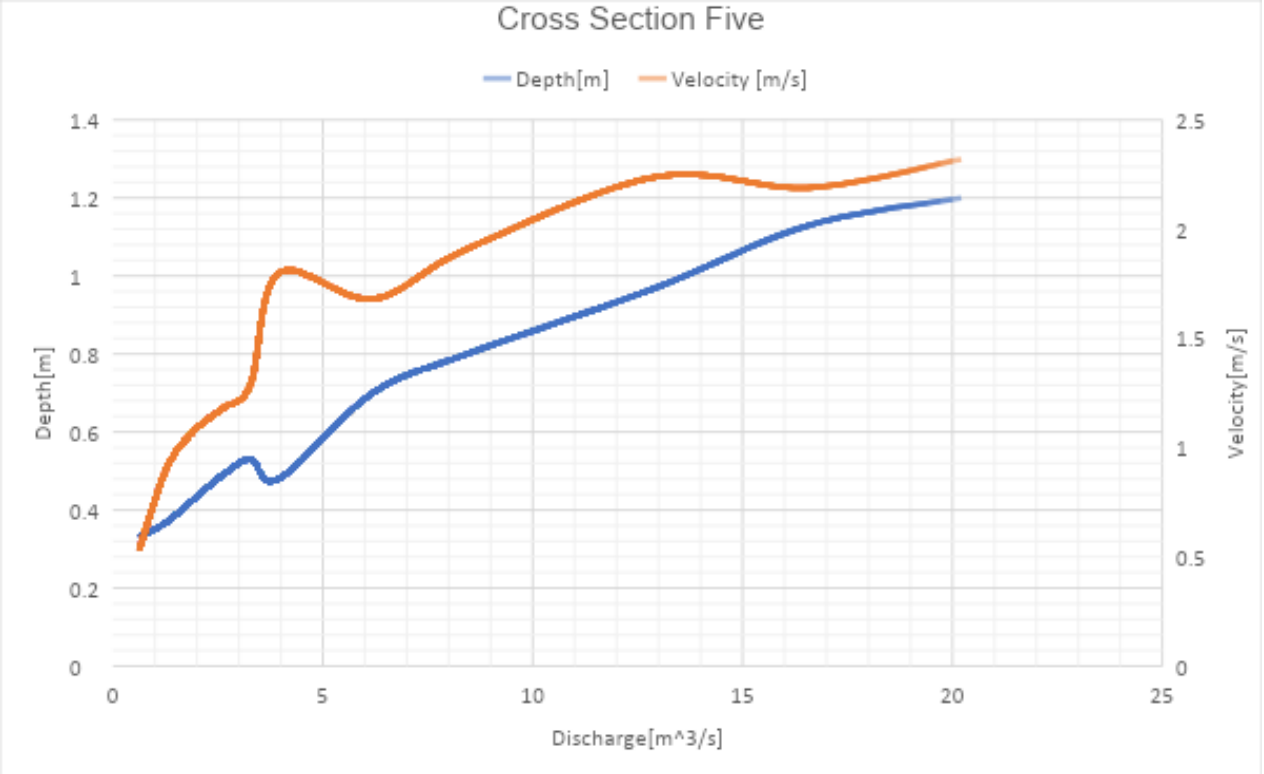

Figure 5-101: Cross Section Five Discharge

Photo 5-38: Cross Section Five field visit

Cross section Six

Table 5-57: Measured discharge details for Cross-Section Six

Width (m)	9.315
Area (m2)	3.247
Mean Speed (m/s)	0.710
Total Q (m3/s)	2.140
Mean Depth	0.42
Maximum Depth	0.65

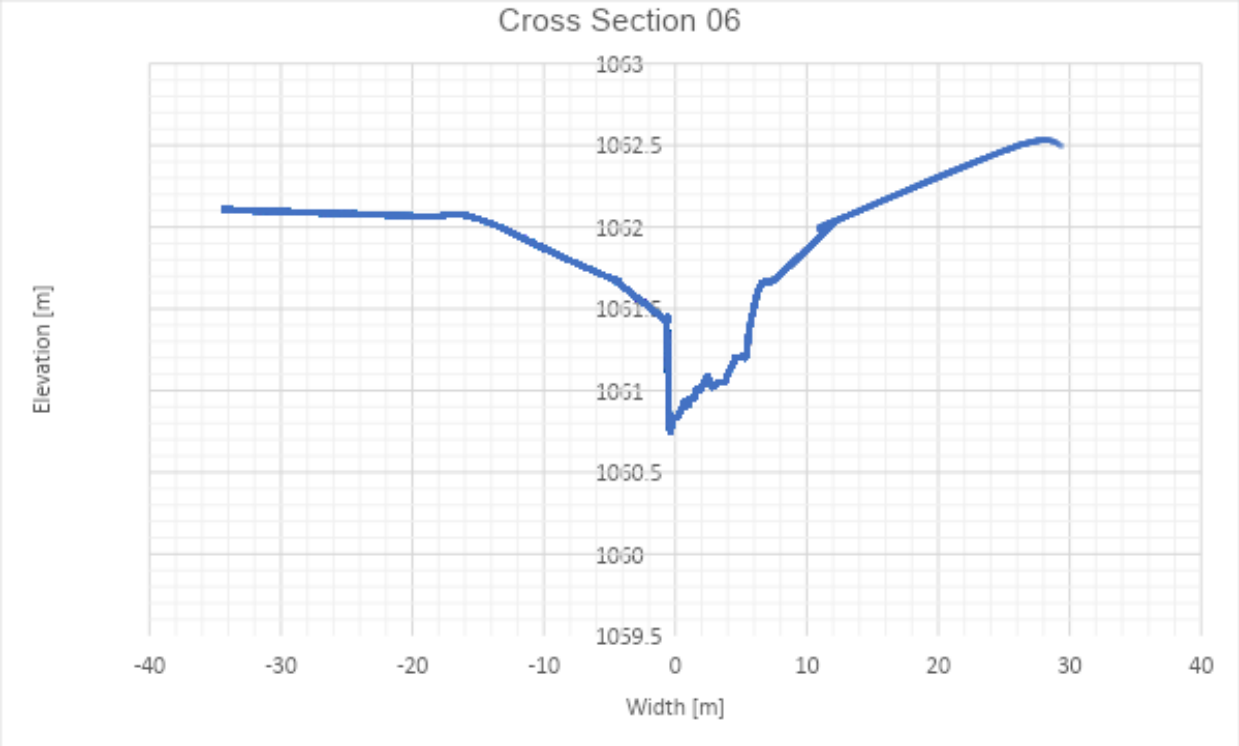

Figure 5-102:Cross Section Six Profile

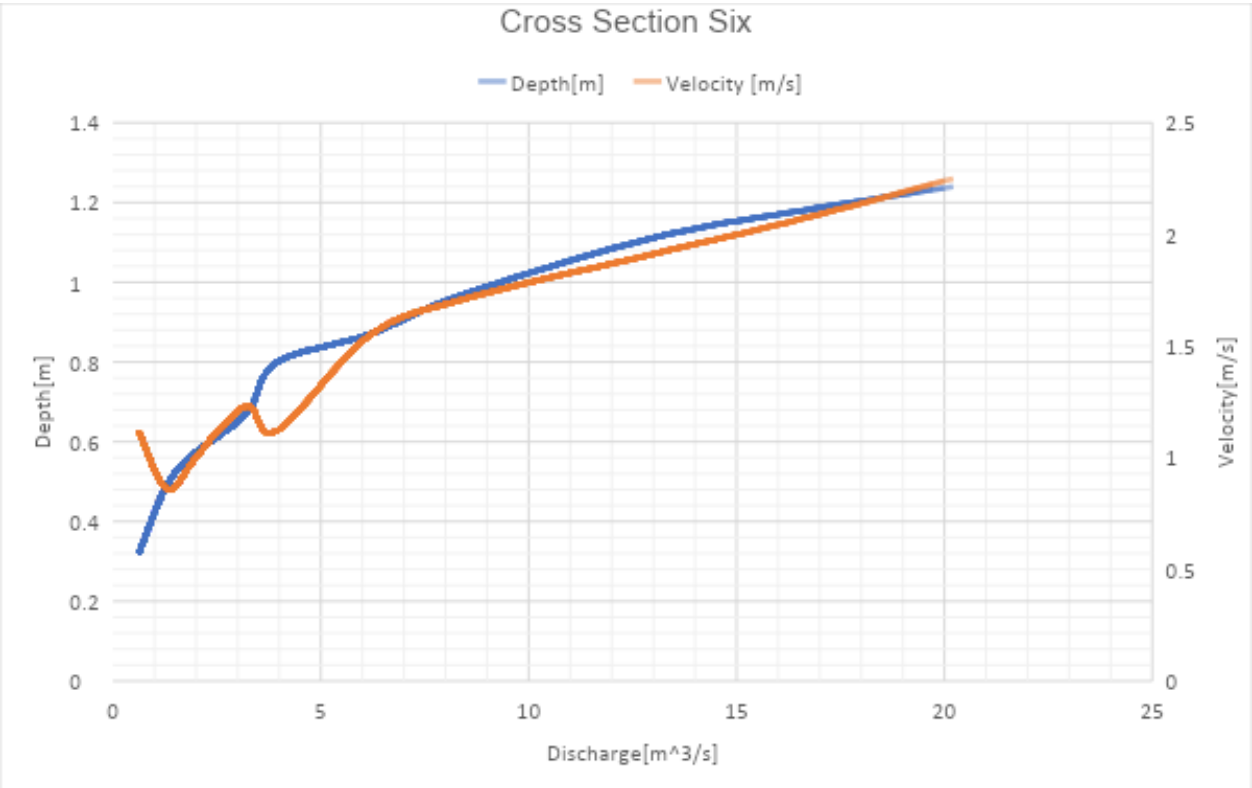

Figure 5-103: Cross Section Six Discharge

Photo 5-39: Cross Section Six field visit

Cross section Seven

Table 5-58: Measured discharge details for Cross-Section seven

Width (m)	6.671
Area (m2)	3.275
Mean Speed (m/s)	0.490
Total Q (m3/s)	1.598
Mean Depth	0.50
Maximum Depth	0.82

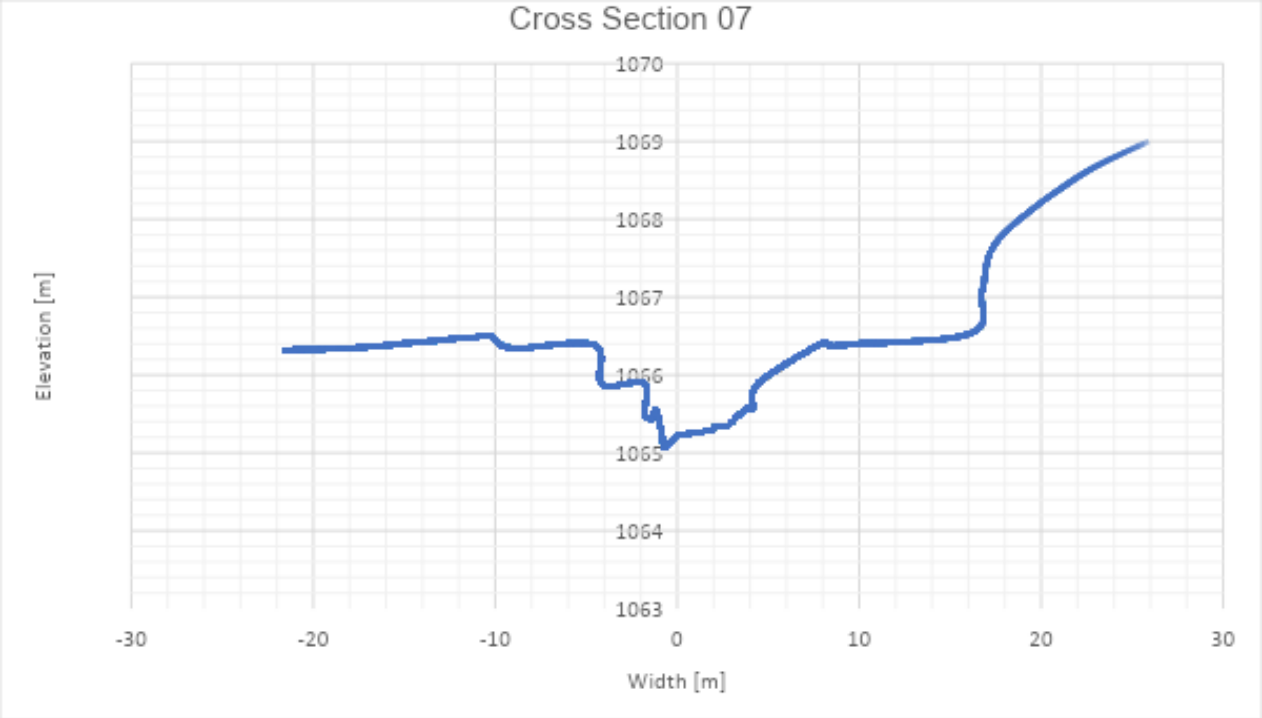

Figure 5-104: Cross Section seven Profile

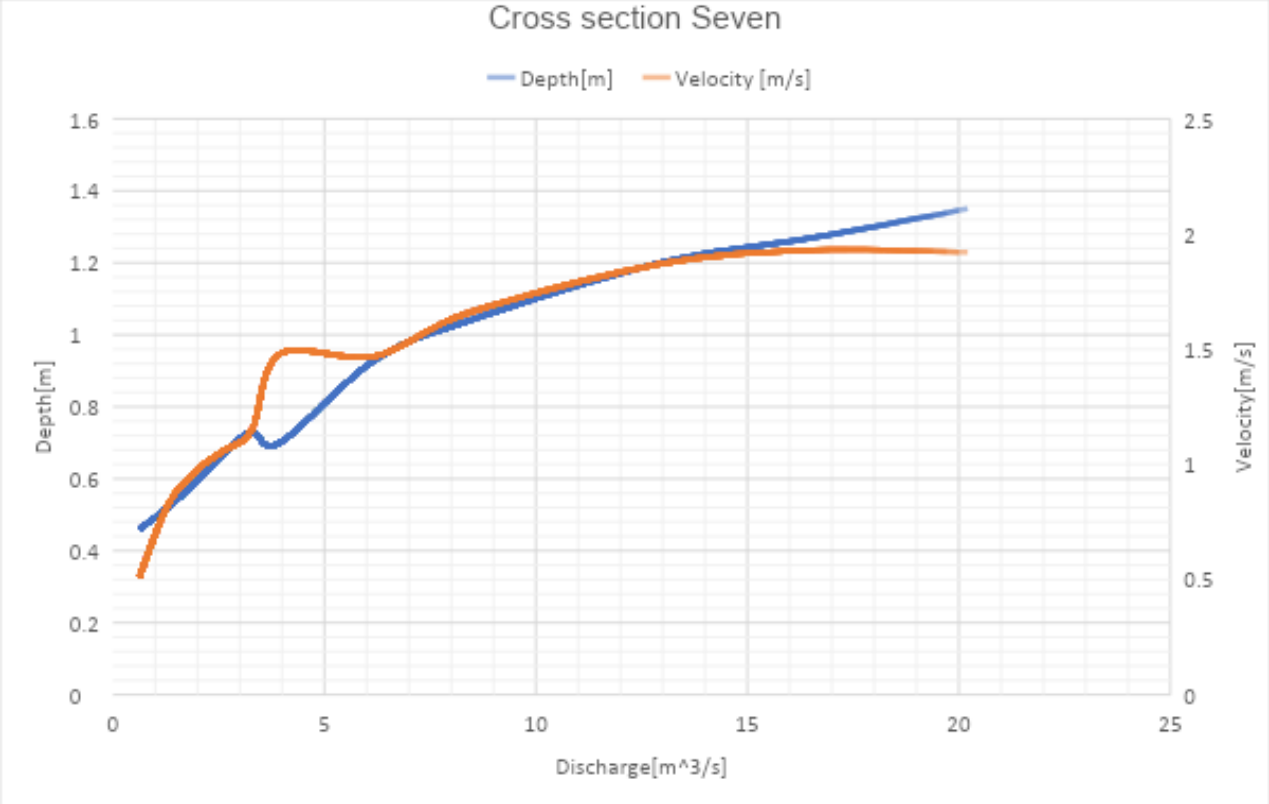

Figure 5-105: Cross Section seven Discharge

Photo 5-40: Cross Section seven field visit

Cross Section Eight

Table 5-59: Measured discharge details for Cross-Section Eight

Width (m)	6.669
Area (m2)	2.681
Mean Speed (m/s)	0.772
Total Q (m3/s)	2.068
Maximum Speed	1.543
Mean Depth	0.35
Maximum Depth	0.49

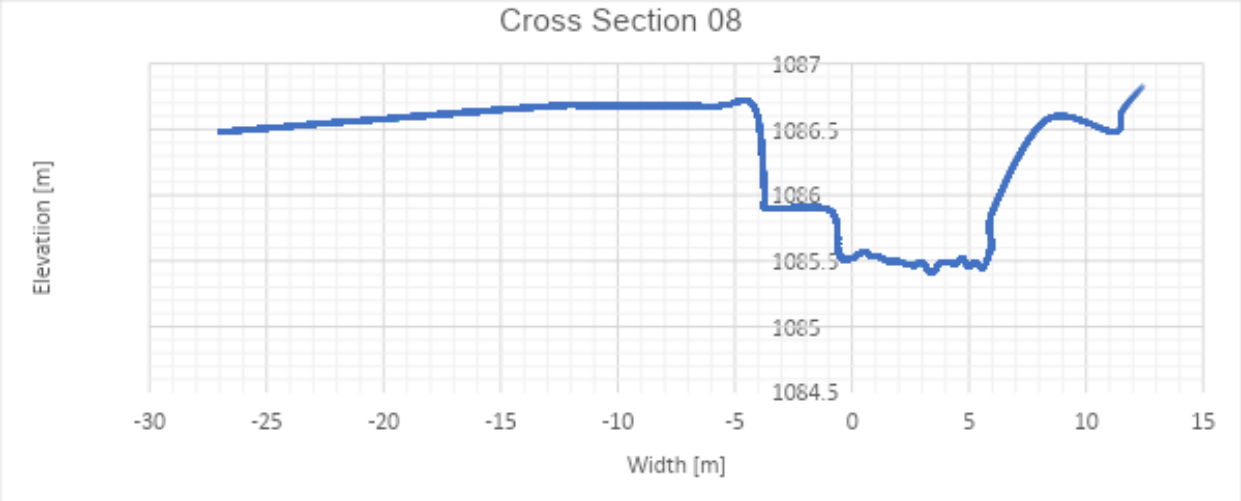

Figure 5-106: Cross Section Eigh Profile

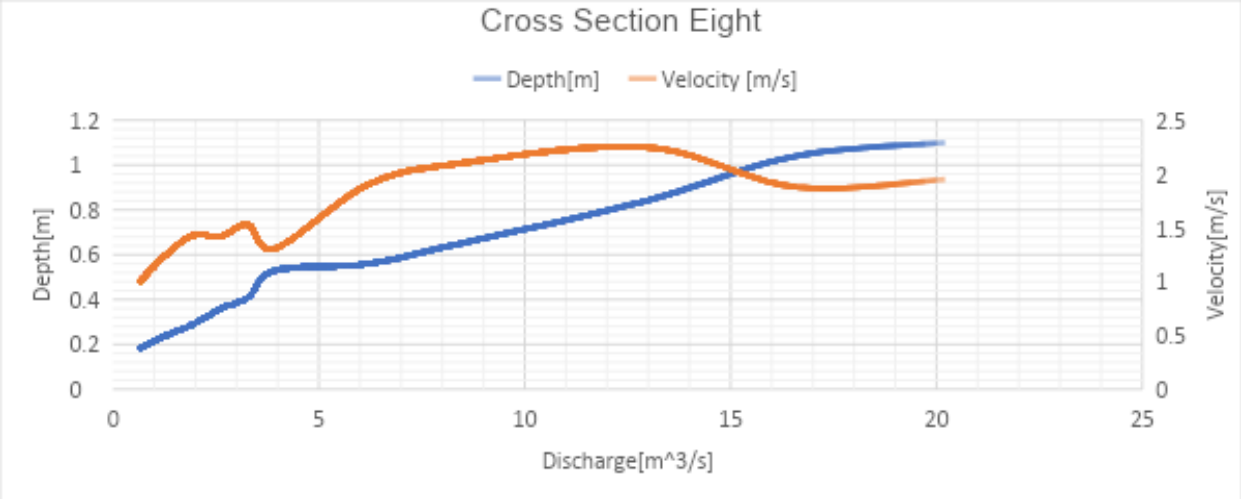

Figure 5-107: Cross Section Eigh Discharge

Photo 5-41: Cross Section Eight field visit

Cross Section Nine

Table 5-60: Measured discharge details for Cross-Section Nine

Width (m)	7.111
Area (m2)	2.253
Mean Speed (m/s)	0.527
Total Q (m3/s)	1.152
Mean Depth	0.32

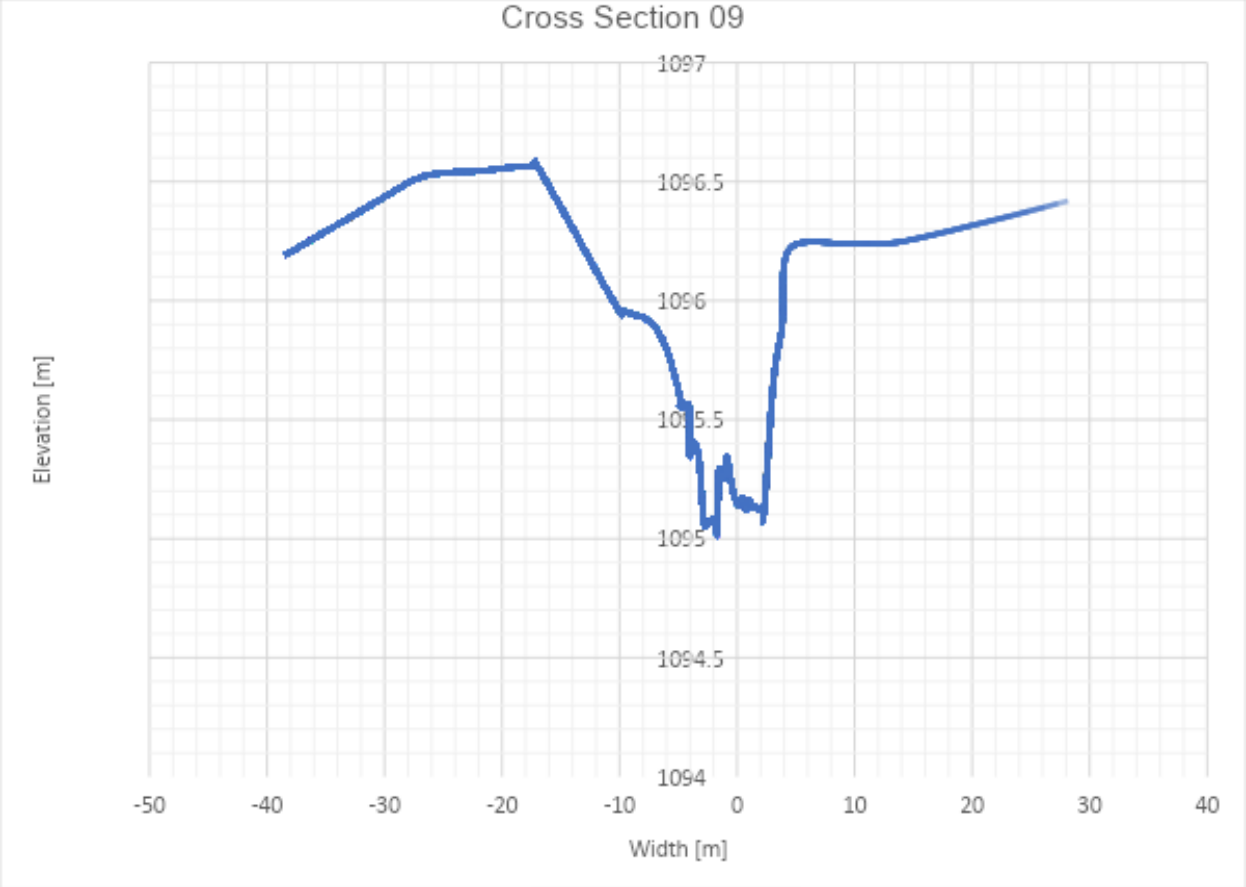

Figure 5-108: Cross Section Nine Profile

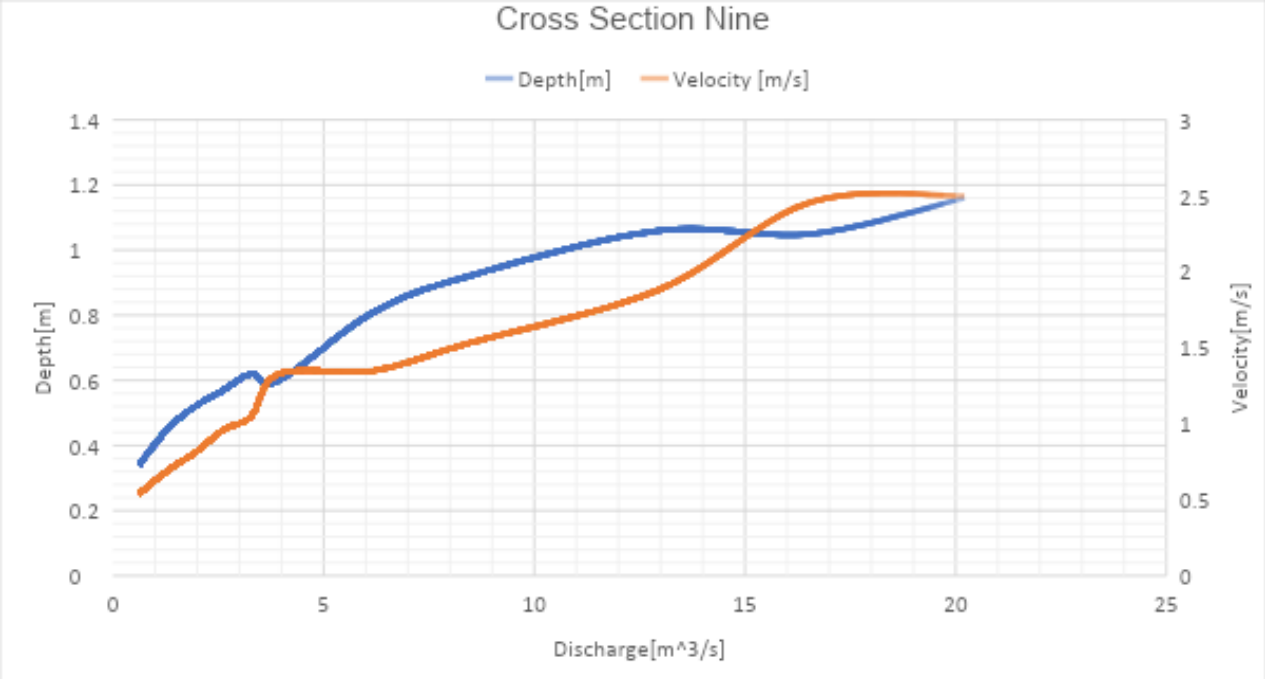

Figure 5-109: Cross Section Nine Discharge

Photo 5-42: cross section nine field visit

Cross section Ten

Table 5-61: measured discharge details for cross-section ten

Width (m)	6.097
Area (m2); 1.844	
Mean Speed (m/s)	0.542
Total Q (m3/s	0.841
Mean Depth	0.24
Maximum Depth	0.54

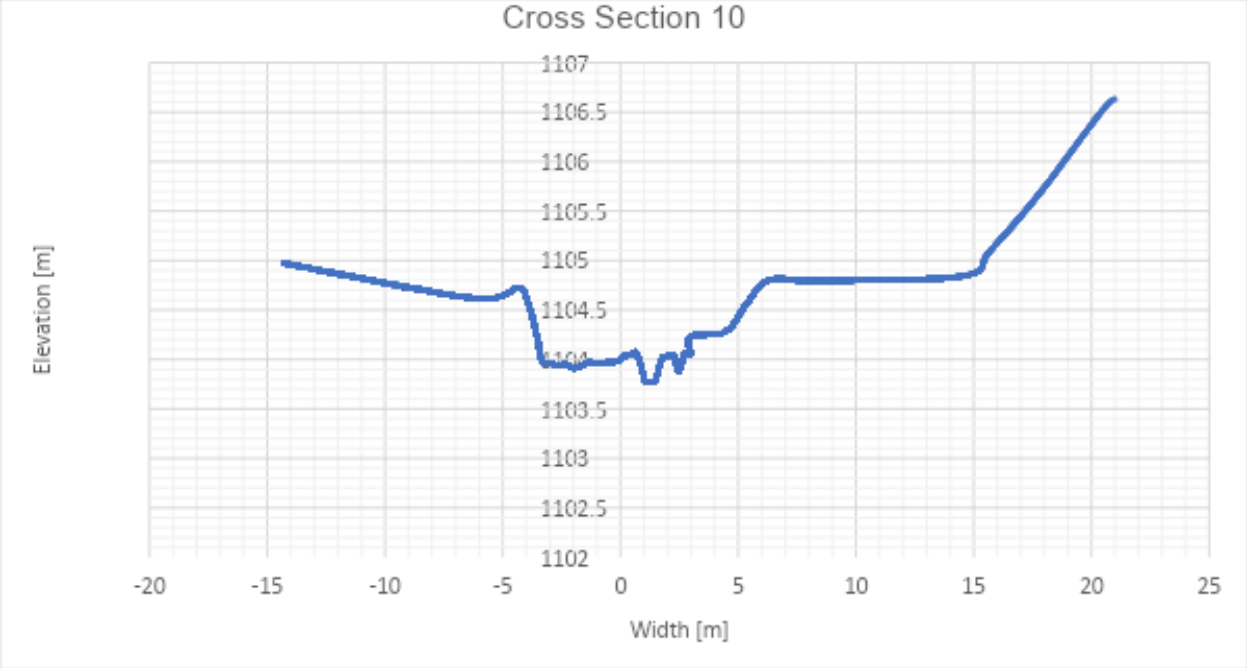

Figure 5-110: Cross Section Ten Profile

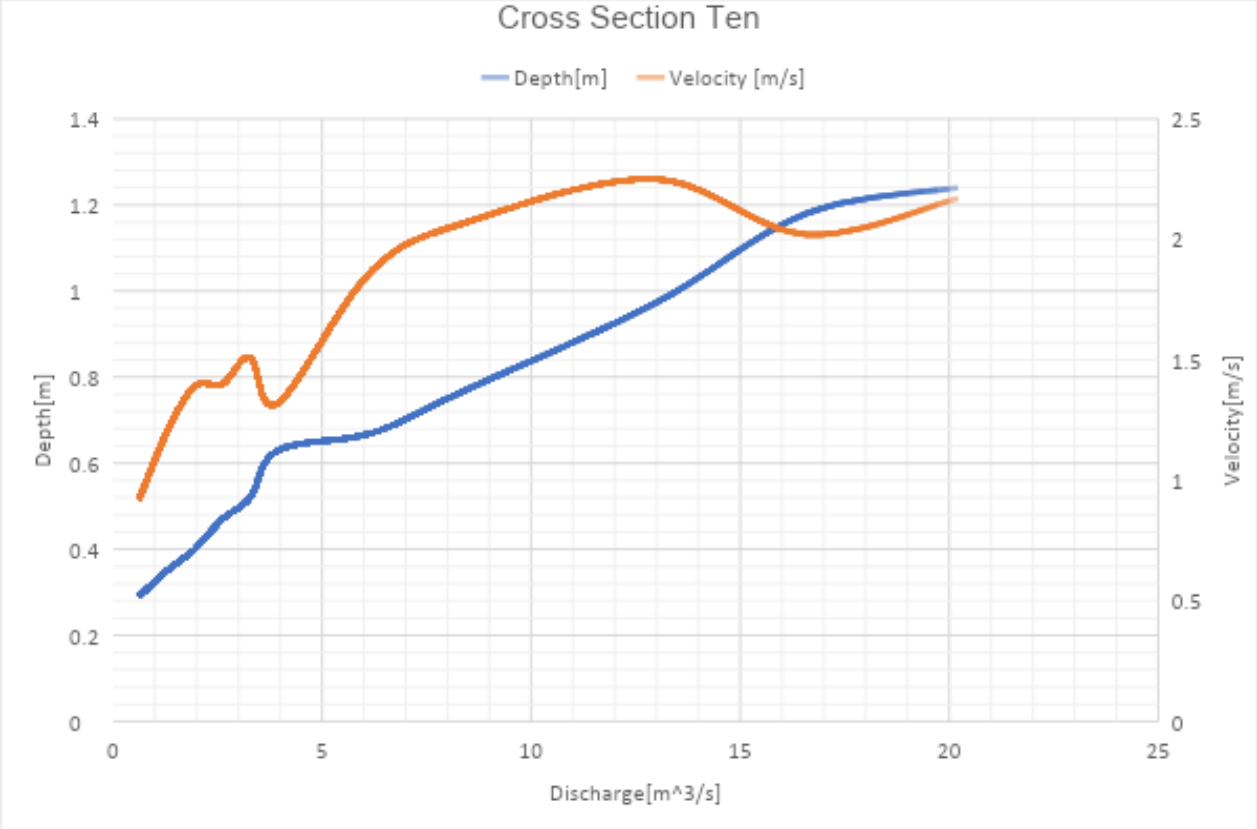

Figure 5-111: Cross Section Ten Discharge

Photo 5-43: Cross Section Ten field visit

Cross Section Eleven

Photo 5-44: Measured discharge details for Cross-Section Eleven

Width (m)	8.015
Area (m2)	2.781
Mean Speed (m/s)	0.210
Total Q (m3/s)	0.566
Mean Depth	0.32
Maximum Depth	0.53

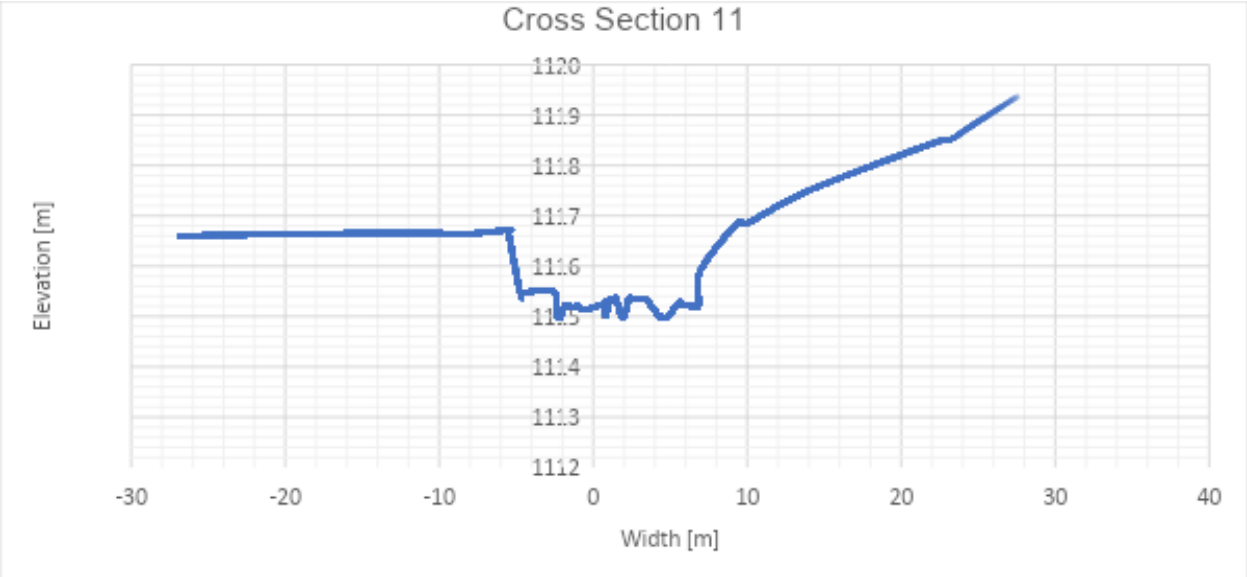

Figure 5-112: Cross Section Eleven Profile

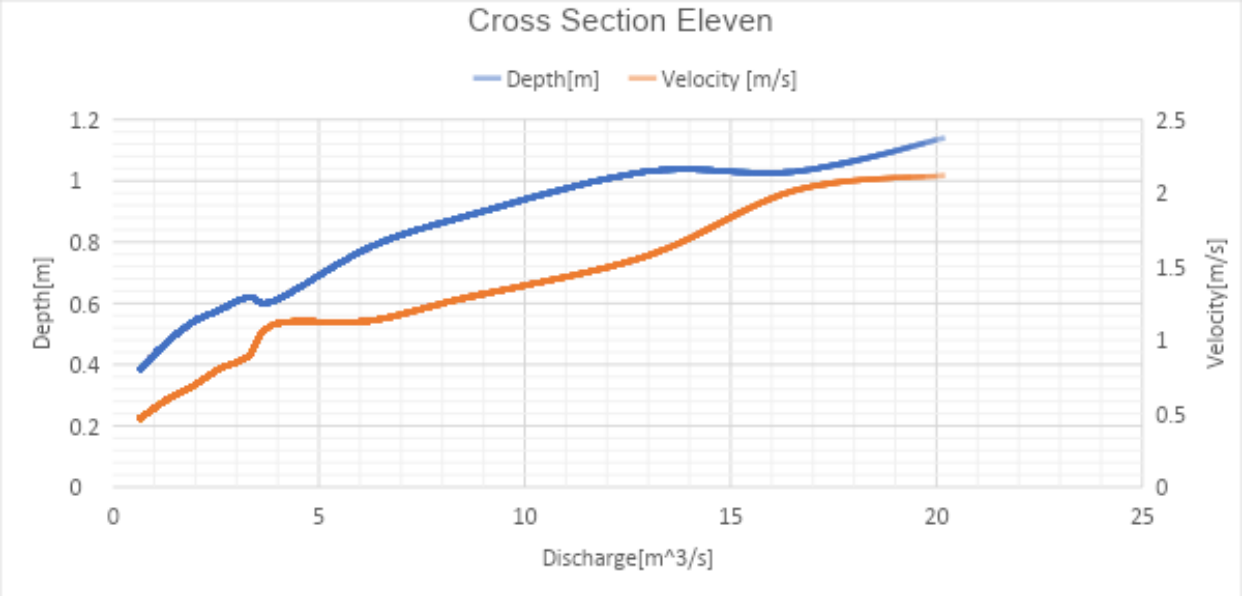

Figure 5-113: Cross Section Eleven Discharge

Photo 5-45: Cross Section Eleven field visit

Cross section Twelve

Photo 5-46: Measured discharge details for Cross-Section Twelve

Width (m)	7.36
Area (m2)	1.79
Mean Speed (m/s)	0.413
Total Q (m3/s)	0.635
Mean Depth	0.29
Maximum Depth	0.57

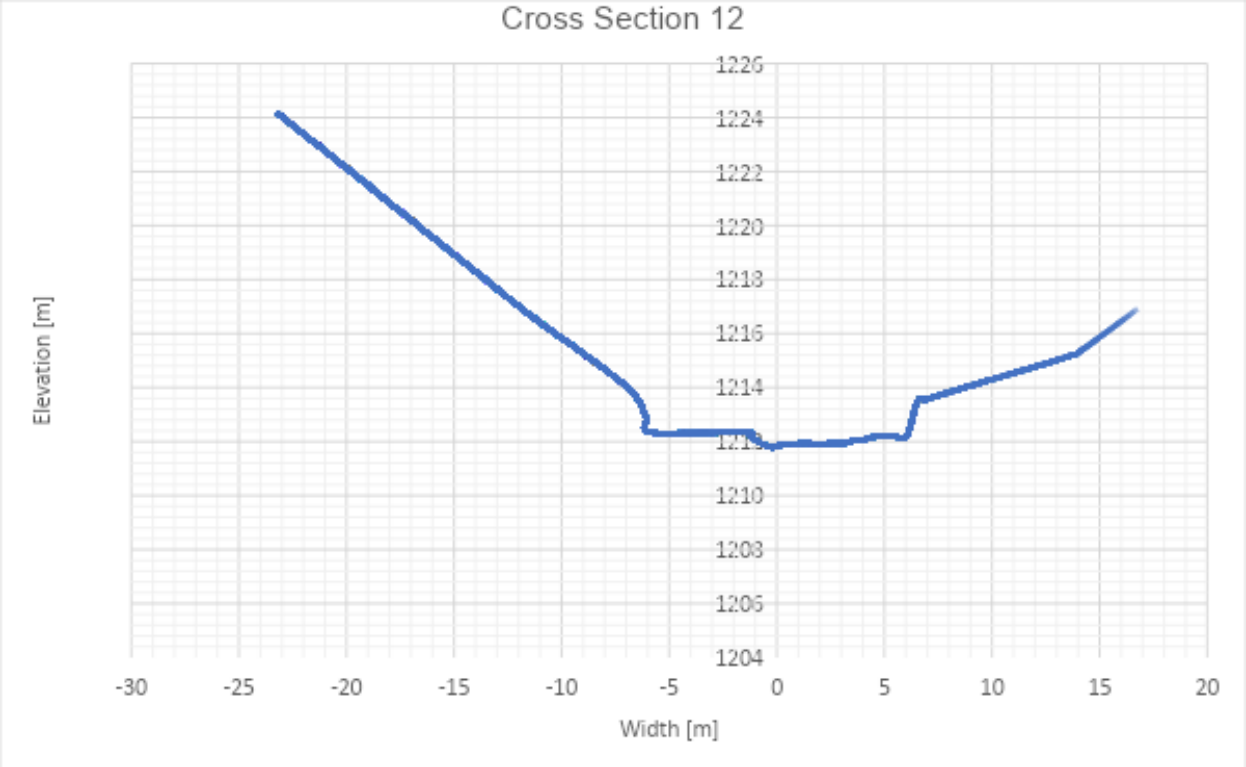

Figure 5-114: Cross Section Twelve Profile

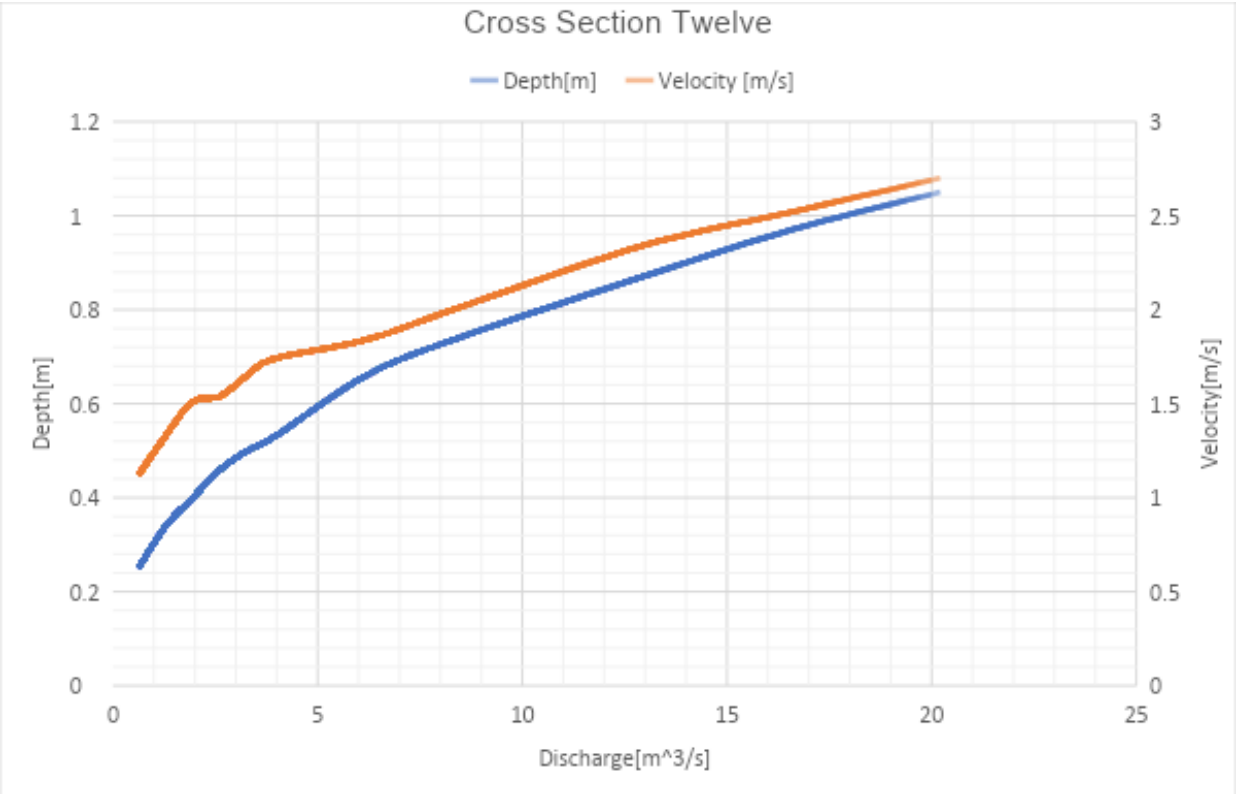

Figure 5-115: cross section twelve discharge

Photo 5-47: Cross Section Twelve field visit

Cross section Thirteen

Photo 5-48:Measured discharge details for Cross-Section Thirteen

Width (m)	5.167
Area (m^2)	1.678
Mean Speed (m/s)	0.558
Total Q (m^3/s)	0.916
Mean Depth	0.41
Maximum Depth	0.60

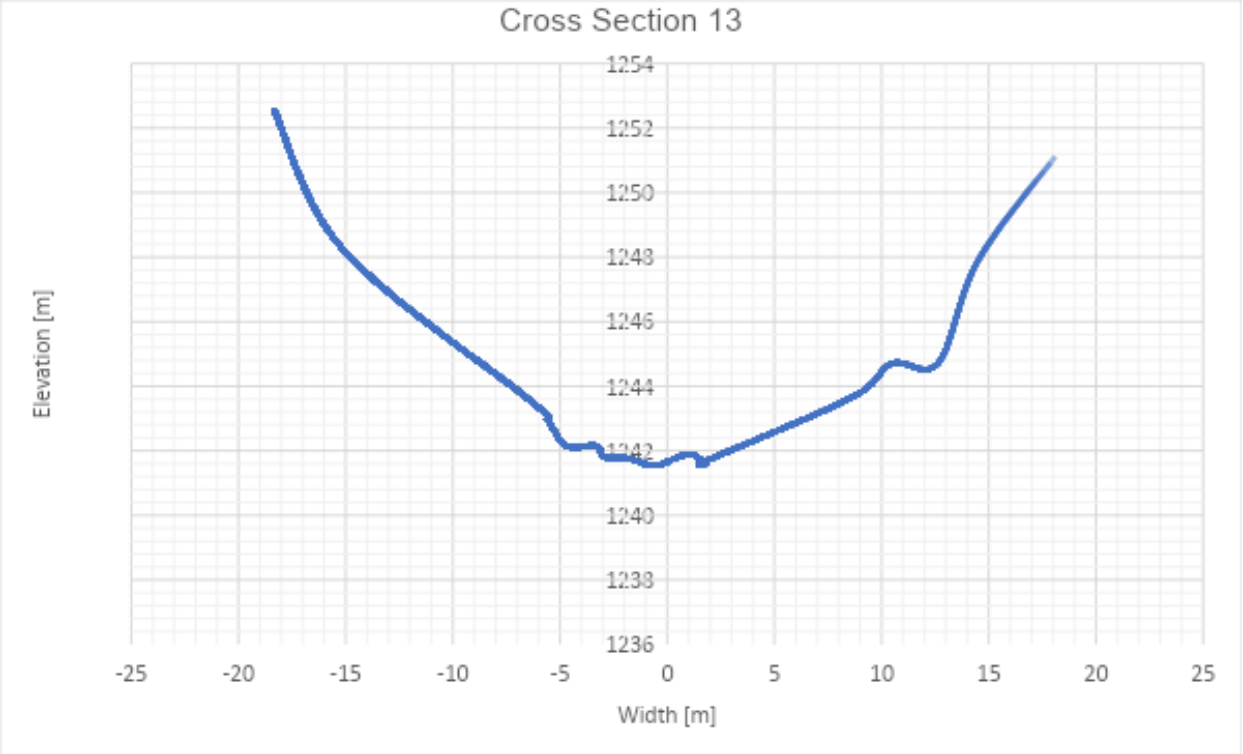

Figure 5-116: Cross Section Thirteen Profile

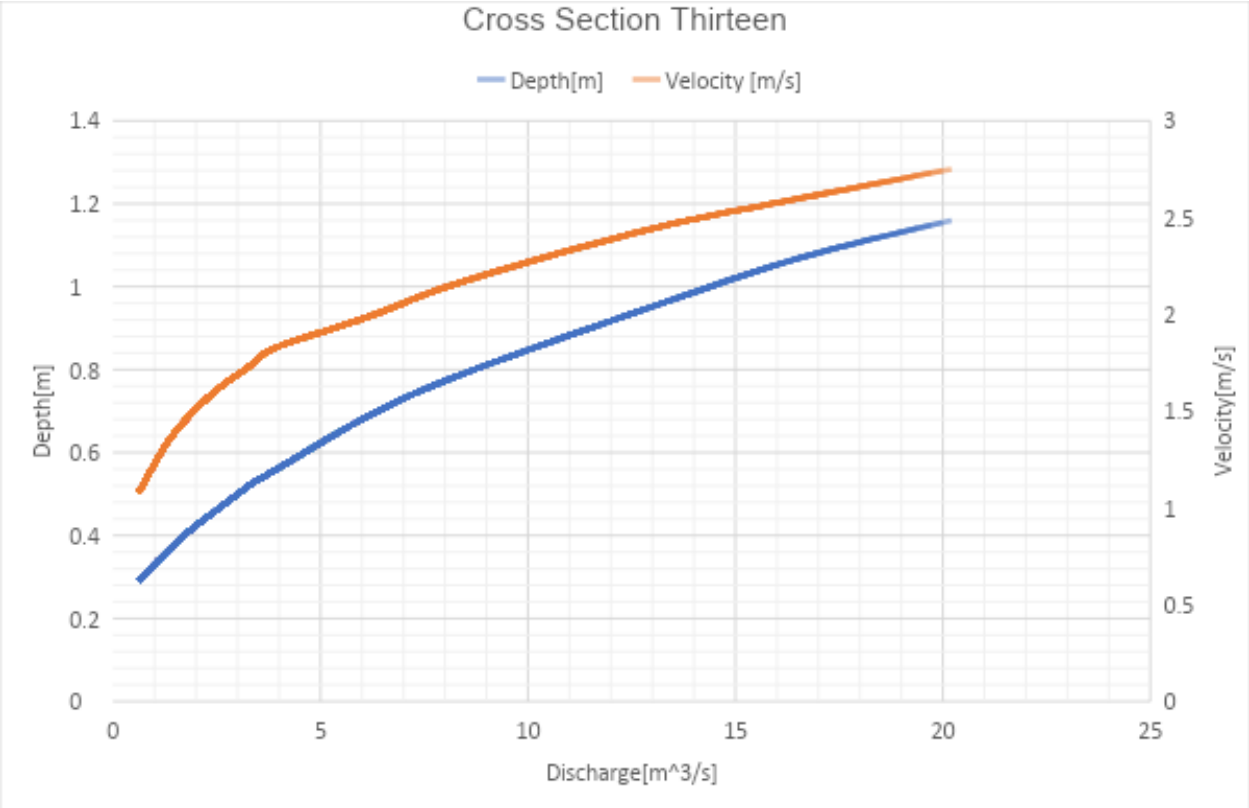

Figure 5-117: Cross Section Thirteen Discharge

Photo 5-49: Cross Section Thirteen field visit

Cross section Fourteen

Table 5-62: Measured discharge details for Cross-Section Fourteen

Width (m)	4.90
Area (m^2)	1.817
Mean Speed (m/s)	0.922
Total Q (m^3/s)	1.143
Mean Depth	0.35
Maximum Depth	0.47

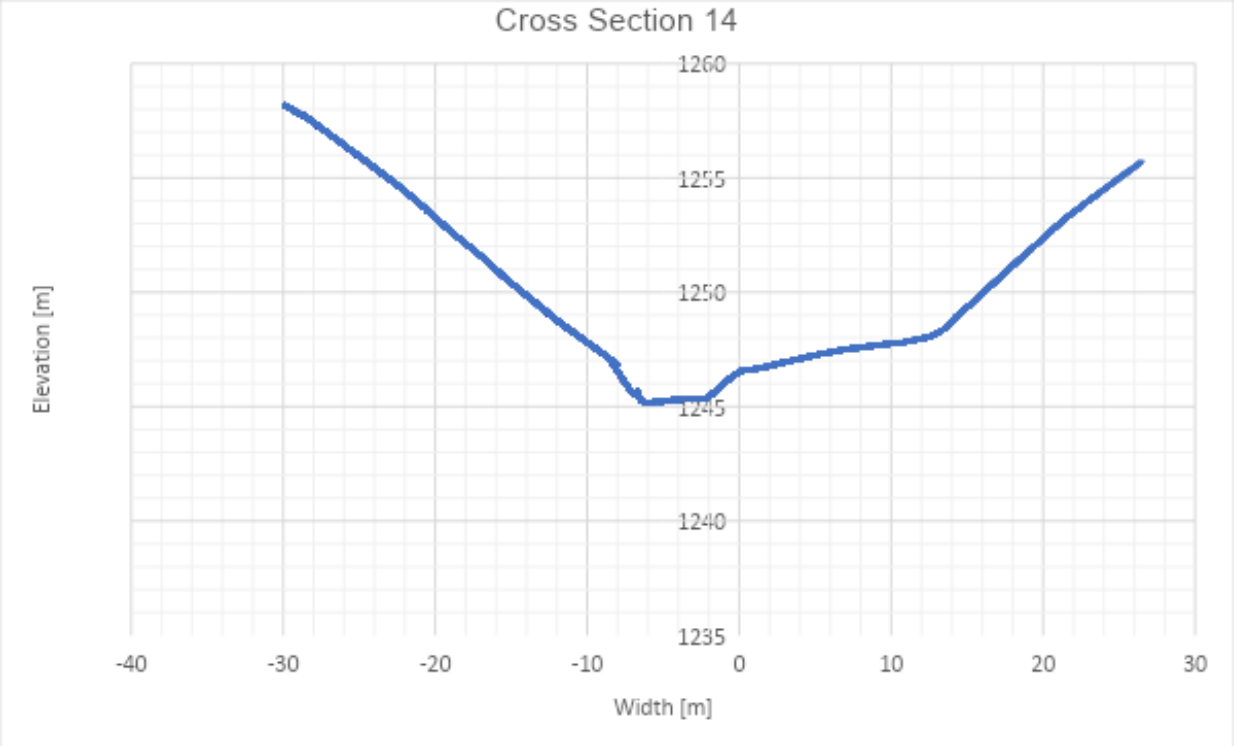

Figure 5-118 Cross Section Fourteen Profile

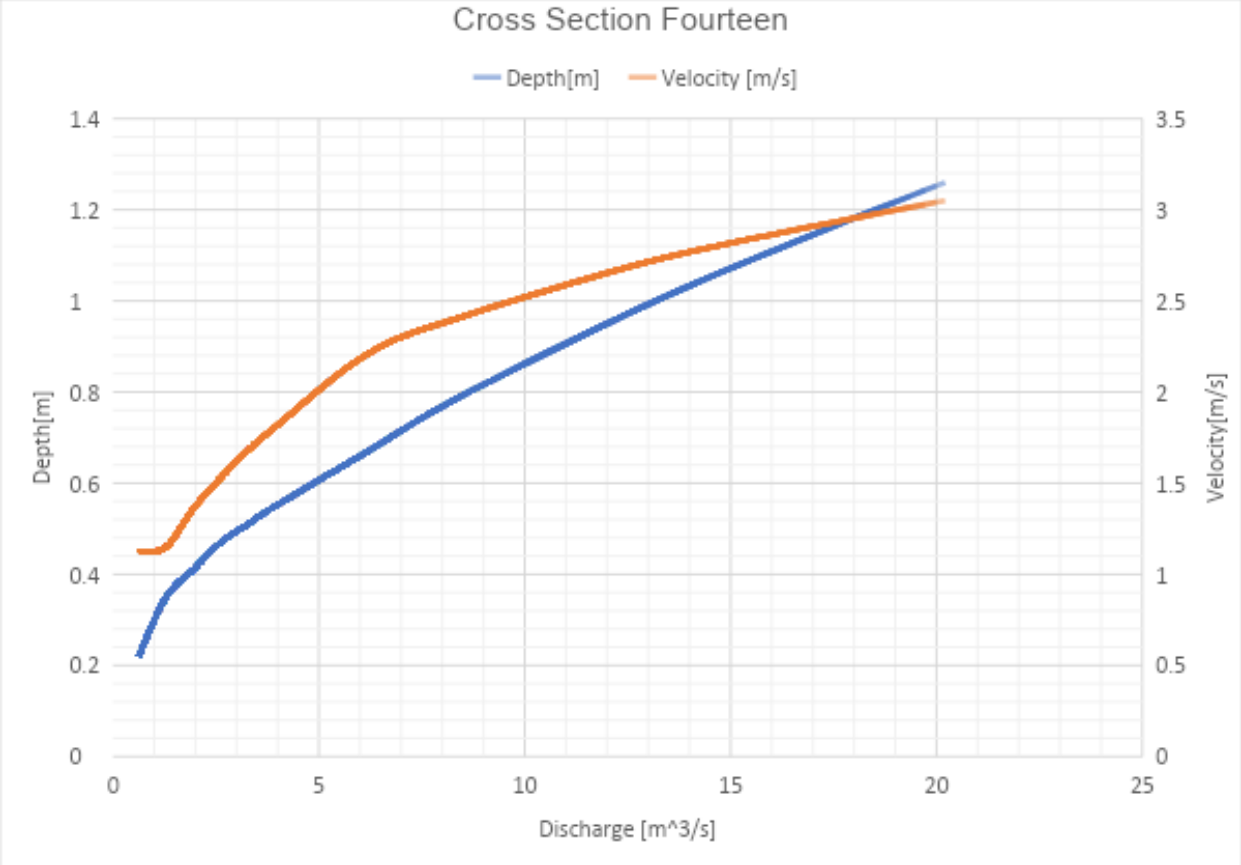

Figure 5-119: Cross Section Fourteen Discharge

Photo 5-50: Cross Section Fourteen field visit

B. Channel dynamics and stability

The structure, pattern and dimensions of the river channel interact with discharge to control or influence the availability of instream habitat at several scales. Channel changes can be classified into three broad categories: (i) channel enlargements or reductions, (ii) channel aggradation or degradation, and (iii) changes affecting the size distribution of materials.

Channel enlargements and reductions: Changes in water use or land use that increase runoff often result in an increase in the magnitude of and frequency of high flow events. Increased frequency of channel-forming discharges is often associated with increased bank erosion. Consequently, one of the first indications of channel enlargement is an increase in width. During channel enlargements, the width to depth ration may stay about the same, so an increase in depth may occur at the same time. Because meander wavelength and riffle spacing are both related to channel width, an increase in channel width may also signal an impending reduction in sinuosity and a lengthening of the distance between riffles. Predictably, channel reductions result from conditions that are diametrically opposed to those causing enlargement, but with the added factor of vegetation encroachment. When the dominant discharge is reduced, areas near the stream margins or on sand bars can become colonized by vegetation. As the vegetation takes hold, it not only stabilizes the deposit but acts as sediment trap when the deposit is inundated. Over time, the deposit accretes in elevation and will ultimately form a natural levee or a new bank.

Aggradation and degradation: Aggradation and degradation are responses of the channel to imbalance between sediment inflow and the transport capacity of the stream. Aggradation occurs when the supply of sediment exceeds the transport capacity of the stream. Aggradation can occur if sediment production from the watershed increases without a corresponding increase in dominant discharge. This form of disequilibrium can also occur if sediment production remains constant and the dominant discharge is reduced either in frequency or magnitude. The imbalance between sediment supply and transport capacity results in deposition and storage of sediment in the active channel. If the cause of the aggradation is a reduction in stream flow with no change in sediment yield, the result will likely be bank building and channel reduction. If aggradation is caused by an increase in sediment production with no change in discharge, the most typical channel response is an increase in the width-to-depth ration. Sediment is stored in the channel, which decreases the depth and increases the erosive force against the banks, which widens the stream. In extreme cases, aggradation can lead to a wholesale change in channel pattern and structure from straight or meandering to braiding.

Degradation results when the transport capacity of the stream exceeds the sediment yield from the watershed. The construction of dams in alluvial streams is probably the most common cause of channel degradation. The sediment normally carried by the stream is deposited in the reservoir. The energy once dissipated by moving the sediment in the channel is now available to the stream to erode its bed. As the channel bottom is eroded downward, the shallow portions of the stream are inundated less frequently. As the stream continues to degrade, the old streambed becomes the new floodplain and the old banks become

terraces. The width-to-depth ratio of the incised channel may be considerably less than that of the original. Consequently, when the degraded channel finally equilibrates, it will commonly have a sinuosity much greater than the original channel.

Channel materials: Changes in channel pattern and structure are commonly accompanied by alterations to in bed material composition. Modification of the substrate is almost a foregone conclusion when aggradation or degradation occurs in an alluvial channel, but substrate changes can occur on bedrock and colluvial channels as well. Although these channels might be less susceptible to channel changes than alluvial channels, they may be vulnerable to more subtle, but equally detrimental, changes in substrate. Essentially, there are only two types of substrate change: those that cause the particle size distribution to become coarser and those that cause it to become finer. The particle size distribution refers to the mixture of different-sized materials in the substrate matrix. Embeddedness is a subset of the particle size distribution, referring to the degree to which the interstitial spaces between the larger substrate materials are filled with fine particles. Both aspects of particle size distribution can have important biological ramifications. When a stream degrades, the smaller materials in the substrate matrix are more easily eroded than the larger materials. Sands and silts are removed first, leaving behind the gravel, cobbles, and boulders. Then the gravels are eroded, leaving the cobles and boulders. Eventually, the boulders may be the only materials left in the channel that can not be moved by the stream. This process of continuous winnowing away of the smaller materials and leaving a veneer of larger ones is known as armoring.

Although armoring is a common result of channel degradation in alluvial streams, a related phenomenon can occur in bedrock or colluvial channels. Alluvial materials such as cobbles and gravel, are normally recruited to bedrock channels during high runoff events. As the discharge recedes, some of these particles will be deposited in the channel. During the next high flow episode, the deposits are eroded and then replaced. If the source of these materials is suddenly cut off by construction of dam, previously deposited alluvium will be removed but will not be replaced. In a very short time, there will be substantially fewer, less extensive deposits of gravel and cobble in the channel, it there are any left at all.

A stream undergoing channel reduction or aggradation will often experience a decrease in particle size and increased embeddedness. As there is more sediment load in relation to the sediment transport capability, the stream has less energy available to move all sediment sizes. Eventually, a veneer of silt and sand can be deposited over the previous streambed surface. Sometimes, the depth of the deposit can be more than a thin layer.

According to King et al., 2008, maintenance of substratum characteristics is relevant mainly to gravel bed and sand bed rivers as opposed to bedrock rivers and is important at two levels. Fine materials are flushed from the surface matrix of gravel bed rivers on a seasonal basis, whilst overturning and transport of the coarse matrix occur less frequently. The first process enhances suitability of the riverbed for fish spawning and helps to maintain an open matrix that provides refuge for invertebrates during inclement conditions such as floods. The second process cleanses coarse material of fine debris and algae and maintains channel structure. It is therefore important that the EFA includes consideration of components of the flow regime that

can perform these functions. 'Flushing' flows are small floods of relatively high frequency, that may occur two or three times a year. 'Overturning' flows are of a higher magnitude and occur less frequently, perhaps once every one to five years. Site-related criteria needed when ascertaining such critical flows include the particle size distribution of the bed material, the discharges needed to move different-sized particles, channel gradients, and cross-section hydraulic geometry. Also important is the rate of sediment supply from upstream, which depends on both upstream channel storage and catchment inputs via tributaries. It has become common practice to recommend one flood discharge approximating to the bankfull level in the active channel.

This is to be provided every one to two years and timed to link with flood-producing storm events of this magnitude over the catchment (King et al., 2008). Geomorphological and sedimentary processes affected by each intra- and inter-annual flood and predictions of the attendant physical changes likely at each site were adopted from Arthington et al. (2003). These descriptions of physical changes were used to evaluate the ecological consequences of loss of floods. Peak discharges of Class I intra-annual floods are responsible for increasing channel surface area and habitat availability, and would mobilize sand and finer sediments, allowing them to be transported through the site. Reducing the number of such floods would affect particle movement and therefore sedimentation rates, timing, and frequency, as well as reducing the area of habitat available for fish.

Inter-annual floods perform the following functions: 1 in 2-year floods initiate motion of dominant cobbles in riffles/glides and on bar surfaces, flush sediments from interstitial spaces and inundate upper bench surfaces; 1 in 5-year floods provide bank full discharge and maintain the size of the active river channel; 1 in 10-year floods inundate upper floodplain terraces, whereas floods greater than or equal to the 1 in 20 year flood inundate the macro-channel or valley trough, and determine the size of the microchannel (Arthington et al.,2003).

The impact of changes in the sediment regime was analyzed using the *Hjulström-Sundborg diagram* presented in the Figure 5-120 below and the equation for sediment concentration in alluvial channels proposed by Yang (1973).The different flows were analyzed to investigate the possible changes in the deposition and settlement potential of various sediment particles noting their existence as settled materials /substrate or in suspension based on the expected velocities under the different flow regimes.

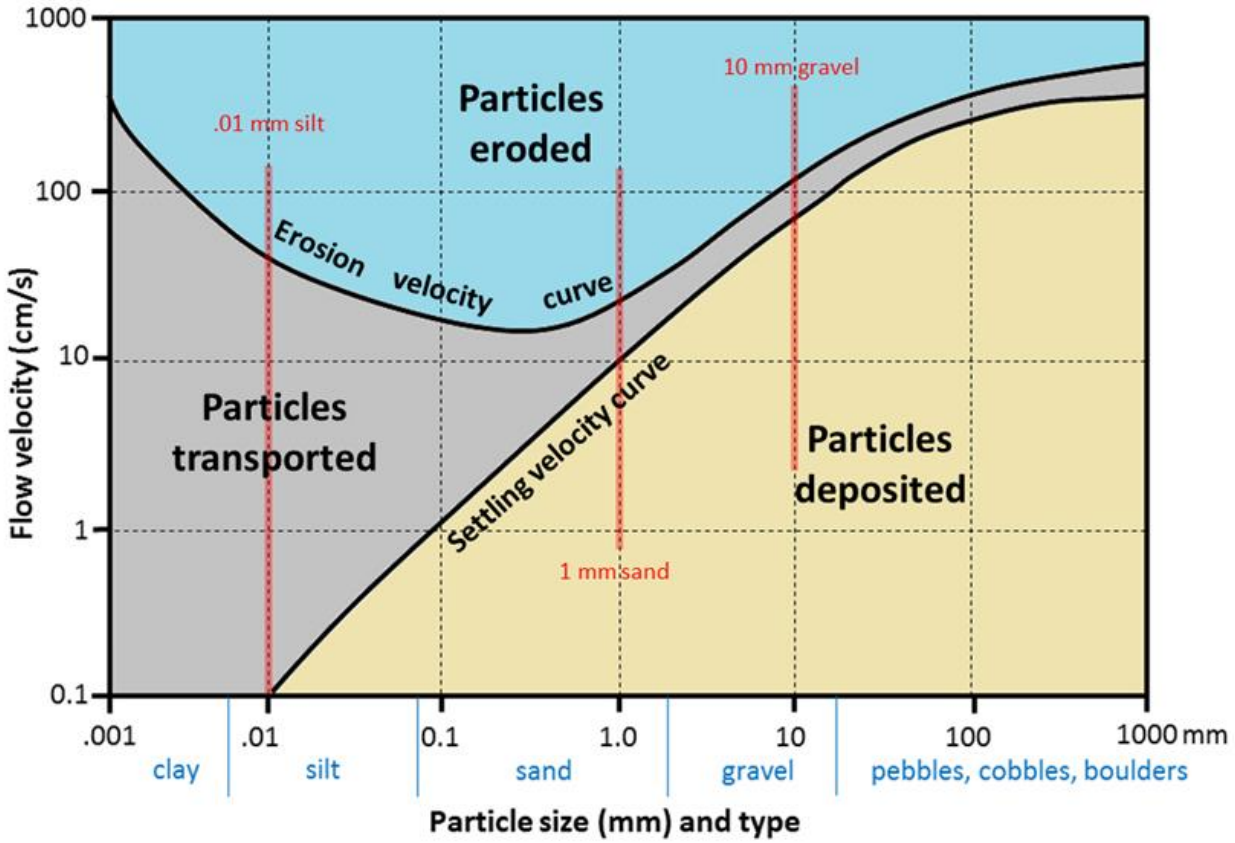

Figure 5-120*: The Hjulström-Sundborg diagram showing the relationships between particle size and the tendency to be eroded, transported, or deposited at different current velocities.*

Yang (1973) proposed that the unit stream power, VS, defined as the time rate of potential energy dissipation per unit weight of water, is the dominant factor in determining the sediment concentration in alluvial channels. The relationship between the unit stream power and the total sediment concentration, Ct, is expressed by (Ibro, 2011 & White et al., 1973):

$$log_{10}C_t - \gamma = \beta log_{10}\{(VS_f - V_{cr}S_f)/\omega\}$$

Where

C_t is sediment concentration (ppm by weight)

V is flow velocity (m/s)

V_{cr} is critical flow velocity (m/s)

S_f is energy gradient

ω is sediment terminal fall velocity (m/s)

$$\beta = 1.799 - 0.409log_{10}\left(\frac{\omega d}{\nu}\right) - 0.314log_{10}\left(\frac{u_*}{\omega}\right)$$

$$\gamma = 5.435 - 0.286log_{10}\left(\frac{\omega d}{\nu}\right) - 0.457log_{10}\left(\frac{u_*}{\omega}\right)$$

$$u_* = \left(gRS_f\right)^{0.5}$$

where

$$\frac{V_{cr}}{\omega} = \left(\frac{2.5}{(log_{10}\frac{u_* d}{\nu)-0.06}}\right) + 0.66, \quad 0 < \frac{u_* d}{\nu} < 70$$

or

$$\frac{V_{cr}}{\omega} = 2.05$$

u_* is shear velocity (m/s);
$R$is hydraulic radius (m);
d is medium diameter (m) of soil particles.
ν is kinematic viscosity (m^2/s) of flow.
g is acceleration due to gravity (m/s^2).

$$T_c = C_t \times Q \times 10^{-3}$$

T_c is Sediment transport capacity (kg/s).
Q is discharge [m^3/s]

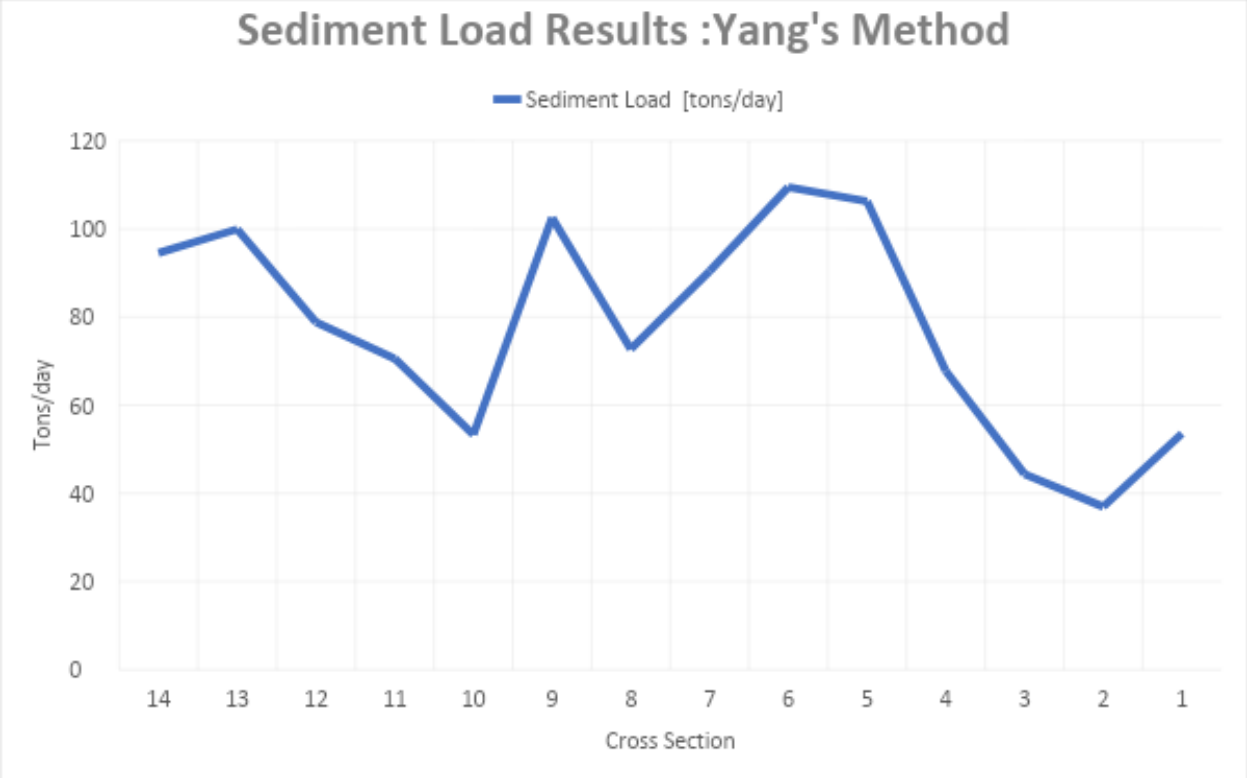

Figure 5-121: *Sediment carrying capacity of sand and silt at a discharge rate of 0.62cumecs*

Table 5-63: Sediment load carrying capacity at a discharge of 0.62 cumecs

Cross section	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Sediment load capacity [tons/day]	53	37	44	67	106	109	90	72	102	53	70	78	99	94

Table 5-64: Estimated sediment yield from the catchment in ton/km^2/year from the feasibility study (MWE, 2022).

Land cover	Area under land cover (km^2)	Erosion rate (ton/km^2/year)	
		Normal case	Worst case
Closed Bushland	8.0	94.52	254.03
Closed Grassland	5.8	48.71	144.10
Dense Natural Forest	2.3	70.00	144.44
Moderate Natural Forest	1.5	51.77	119.96
Open Bushland	22.3	63.51	161.41
Open Grassland	1.6	78.25	395.39
Settlement	0.8	87.94	218.40
Subsistence Cropland	91.9	250.60	539.63

From the Table 5-64 above and approximating the upstream area to be under subsistence farming with an area of 134.2km^2, the sediment loading upstream of the reservoir is approximately 92tons/day. At 87% trap efficiency, 12tons/day are passing through the reservoir.

Analysis of sediment transport

Based on the graphs/diagram above and the historical flows in the river, the following can be concluded:

- The range of historical flows in the river are not capable of moving gravel, pebbles, and particles of a larger size.
- Historical flows are not able to either erode or deposit clay in the river, therefore all clay particles are moved through the river beyond the confluence with R. Mitano.
- The historical flows have the capacity to move, erode, and deposit silt and sand at different river sections and different periods of the year.
- With the sediment trap efficiency estimated at 87% under the normal case only 12tons/day of sediment is allowed to pass through the reservoir. The intervening catchment area is estimated to provide 66tons/day. At section 13, the sediment carrying capacity of the river is 37tons/day implying that even if the river was to carry more sediment, it would be deposited around that cross section. This means that the equilibrium for the sections downstream with higher sediment carrying capacity is satisfied by sources downstream of this cross section for stability. Higher flows would mean high eroding power and would imply further incision of the river channel; however, observation of the river channel shows relative stability. Therefore, stability of river channel downstream of the proposed reservoir may not be dependent on the sediment loading upstream of the reservoir but rather on the intervening catchment areas.
- However, to enhance the sediment load in the river, the channel forming floods shall be at the beginning of the rainy seasons to allowe the high sediment holding flows to pass through the reservoir and also to act as a flushing mechanism to move some of the settled sediment downstream.

Channel forming flows

When applying the BBM, it has become common practice to recommend one flood discharge approximating to the bank full level in the active channel. This is to be provided every one to two years and timed to link with

flood-producing storm events of this magnitude over the catchment (King et al., 2008). From the analysis presented in Table 5-58. The following is the recommended description of the channel forming flows that will be released once in every two years.

Table 5-65: Description of small flood for channel maintenance to be released once in two years.

Small Flood peak [cumecs]	13
Small Flood duration [days]	5
Small Flood timing [Julian days]	289
Small Flood freq. [No per yr]	Once every two years
Small Flood rise rate [Δdisch/day]	5.7cumecs/day
Small Flood fall rate [Δdisch/day]	-4.7/cumecs/day

5.7.5 Riparian Vegetation

Vegetation is a dominant part of most riverine ecosystems, where it fulfils a number of critical functions including the following: stabilizing river channels, banks and floodplains; contributing towards the attenuation of floods; influence water quality; and provide habitat, refuge and migration corridors for terrestrial and aquatic fauna. The structure, composition and overall condition of the vegetation determine the degree to which it is involved in ecosystem functioning. Plant roots bind the surface of the soil to varying extents, providing resistance to erosion by water. The superficial roots of annuals and sedges provide an initial stability to lose substrata, but have little resistance to strong flows. Their shallow roots also render them susceptible to drying out of the substratum. Shrubs and trees are deeper rooted and can utilise subsurface moisture. They tend to survive for longer periods, and their permanent cover lends longer term and greater stability to the land. Plants, by their presence, resist the passage of water. Riverine wetlands are particularly relevant to flood attenuation as they slow the overland flow of water, allowing it more time to soak into the soil.

Slow flows have a low carrying capacity for suspended materials and have low erosive effects. The slowing of current speeds by plants such as the reed therefore limits bank erosion and can result in bank accretion through the deposition of suspended materials. Marginal vegetation creates prime habitat, such as feeding and breeding grounds, as well as shelter, for aquatic insects and juvenile fish. Most trees and shrubs that line waterways are restricted in distribution to the riparian zone and atypical of the larger environment.

Depending on the characteristics of a river reach, riparian vegetation commonly occupies a range of positions relative to the river channel. Marginal vegetation in the form of mesic grasses and sedges is often found on the edges of the wetted area, while other herbaceous and woody species may occupy this area as well as others further away from the river, on the macro-channel floor or macro-channel bank.

This wide distribution of riparian vegetation, and its distinct delineation into vertical zones each linked to different magnitudes, durations and return periods of high and low flows, provide the basis of how vegetation is used to recommend on future flow patterns. Each vegetation zone experiences specific patterns of

inundation and exposure and requires something approximating that flow regime to continue to exist in the river system. Using this knowledge, recommendations on flows for the maintenance of vegetation can be made. These recommendations are not used in isolation, but combined with those provided by other ecological specialists, to give a consensus, holistic recommendation on environmental flows (King et al., 2008).

The present riparian vegetation state is assessed in terms of its species composition, size/age structure, recruitment rate, and distribution and zonation relative to the river and the macro-channel floor and bank. Thereafter, the riparian vegetation dynamics which have evidently taken place over time are considered in terms of their links to prevailing physical and hydrological conditions as well as to non-flow related disturbances that have occurred at the site. Riparian zones are often highly disturbed and, as such, may be totally or partially devoid of riparian vegetation, particularly woody vegetation. The overall picture of site dynamics needs to be developed, and then used to ascertain the extent to which hydrological characteristics and history are responsible for the present state of the vegetation. It is also essential that the vegetation present has some form of indicative value (i.e. indicator types or species). Such vegetation would comprise species with known or partially known water requirements, or whose distribution patterns, age structure or recruitment rates are determined by specific flow-related characteristics of the river at the site. Sites where non-flow related disturbances are the primary determinants of the state of the vegetation have very little value for assessing flow requirements. The disturbances that are usually responsible for this situation are those of large-scale vegetation removal for farming, fuels or building purposes or the impacts of intensive grazing and browsing by livestock. Where such vegetation is incomplete or absent, experience of the riparian vegetation and flora of a region can assist in the reconstruction of critical features, such as the relationship between the floral species present and flow levels (King et al., 2008).

A. Riparian vegetation response guilds

Riparian vegetation–flow response guilds (hereafter riparian response guilds) are defined as groups of riparian plant species that respond in similar ways to quantifiable flow attributes. The riparian response guilds are broadly divided into five categories: life history, reproductive strategy, morphology, fluvial disturbance and water balance. Non-phylogenetic associations of plant communities have been used to predict ecosystem response to disturbance, water depth and exposure, resource gradients and groundwater decline. Because juvenile and adult traits may be independent of one another in wetland and riparian plants, it is necessary to examine these life-stages independently during the development of trait matrices. Such functional classifications provide a broader framework for prediction of response to changes in environmental variables than do analyses of individual species response curves, communities and cover types along gradients. A riparian response guild framework that considers key attributes of riparian vegetation as proposed by Merritt et al., (2010) was used as follows:

Life-history guild

The life-history guild is composed of traits that reflect tradeoffs between individual fecundity and survivor ship within species. Traits in this guild include life span of the individual, a key determinant of response time to a change in hydrologic conditions. The life span of species groups has relevance to the response of such groups to changes in timing and duration of disturbance as well as the length of time between such disturbances. For example, annual or other short-lived plants may be present or absent as a function of seasonal flow regime whereas long-lived riparian forest species may persist for a century or more after the flow-related processes necessary for forest stand formation have ceased. Life span (as opposed to classification as annual or perennial) is a quantitative measure of typical length of life. Different life-history guilds may be used to develop an understanding of the sequence and duration of responses that shall be anticipated following a change in flow regime (Merritt et al., 2010).

Reproductive strategy guilds

Reproductive strategies include: (i) phenology (timing of seed release); (ii) type of regeneration (sexual versus vegetative); (iii) reproductive cycle of the plant (annual, biennial, short and long-lived perennial); (iv) seed longevity or propensity for dormancy and (v) length of time to first reproduction. Because of the typical temporal variability of the flow regime and high resource heterogeneity in riparian areas, numerous reproductive strategies may co-exist in these systems. Phenological adaptations include delayed flowering during submergence and dispersal timed to increase the likelihood of suitable habitat availability during dispersal. Reproductive specialists (responsive to attributes of flow regime) are expected to be sensitive to changes in the timing of various flow components and rates of change in flow. Plants growing in wetlands and stable or uniform riparian habitats exhibit a high propensity for asexual or vegetative reproduction, but sexual reproduction is favoured in highly variable or heterogeneous habitats. Indeed, rivers or river reaches that have more stable flows and less extreme flooding (higher elevation streams, spring-fed streams, swamps, regulated rivers) tend to be dominated by perennial species with vegetative reproduction strategies. Whereas many pioneer species have short-lived seeds, seed longevity can also function as an important reproductive adaptation to disturbance, as species that can form a seed bank may be the first to establish following disturbance (Merritt et al., 2010).

Morphology guilds

Canopy height, canopy volume, root depth and root architecture are among the structural traits of plants responsive to and reflective of hydrologic variability. When changes in flow permanence, total annual discharge and depth to groundwater occur, communities may shift in predictable ways according to traits associated with water acquisition (e.g., root morphology). Shifts from tall forest species to shorter shrublands or meadow may reflect a directional or threshold response to water depletion. The presence of woody and herbaceous vegetation may also be tightly linked to timing and sequencing of floods and duration of inundation. Linkages between physiognomy of the vegetation and flow regime could guide managers in

structuring flows to provide specific native habitat types such as multilayered forest canopies for neotropical songbirds or moist meadows for obligate riparian mammals.

Fluvial disturbance guilds

Many vegetation adaptations are triggered by fluvial disturbances and may vary as a function of natural patterns of disturbance in these systems (magnitude and frequency of flooding). Furrowed bark, flexible stems, and the ability to re-sprout after stems are damaged are all traits that are common to groups of disturbance-adapted woody species living along rivers. These adaptations are readily identified for individual species, and the relative importance of such guilds in the riparian community shall exhibit a strong relationship to characteristics of the flow regime. The ability to root adventitiously from stems is an adaptation both to burial of stems by sediment and to acquisition of oxygenated water in inundated areas. Whereas terrestrial plants rarely experience burial by sediment, burial is a frequent occurrence along free-flowing rivers. Plants may possess tubers, rhizomes and/or pointed shoots to facilitate upward penetration through sediment following burial. Adventitious rooting from stems enables a plant to acquire nutrients, water and oxygen from the accumulated sediment around its stem following burial. Such traits shall be more prevalent in riparian areas with frequent fluvial disturbances and become less prevalent in systems that have naturally low or altered levels of disturbance. Altered disturbance patterns are likely to have a more severe effect on seedlings and earlier growth stages for most species; however, if seeds are available following disturbance or fresh deposits of alluvium provide centres or nodes of colonisation. The proportion of the riparian community with adaptations to disturbance shall be higher in systems with high frequency and magnitude of disturbance. Shifts in this guild will occur in accordance with magnitude and direction of the change at a rate determined to some degree by the life-history traits of those species included in the guild (Merritt et al., 2010).

Water response guilds

In hydrologically variable riparian environments plant species often have adaptations to conditions associated with periods of flooding as well as periods of drought. Species vary greatly in their ability to regulate their water pressure potential (through stomatal closure or other leaf morphologic traits). Many species of riparian plants, particularly in arid regions, require access to a permanent or seasonal water supply and are intolerant of low internal water pressure potentials. Other species may have an affinity for fine textured substrates with high water-holding capacity or may be able to use water at low soil water pressure potentials. Some riparian species can use different water sources over the course of the season, with various proportions of transpired water coming from ground and soil water depending on relative availability. Such species may be better adapted to extended periods of low flow caused by drought, groundwater pumping and water extraction. Plants along streams where surface water has been diverted may exhibit morphologic responses to enhance water-use efficiency, such as reduced leaf size, increased leaf thickness and reduced leaf area. Generally, the ‘water balance’ riparian response guild spans a trait gradient from tolerance of anoxic conditions associated with prolonged flooding to tolerance of periodic soil desiccation. At intermediate positions along soil hydrologic gradients lie groups of riparian species with traits appropriate to hydrologically variable conditions. These species include those individual species with adaptations to conditions of both moisture

excess and scarcity as well as transient, species that occur only when favorable conditions exist (Merritt et al., 2010).

Flow response guild	Traits	Relevant flow component
Life history	Longevity (life span) Annual-perennial-biennial	Frequency of extreme floods
Reproductive strategy	Vegetative-sexual-combined Timing in synchrony with flow component	Magnitude of extreme flow (flood transported ice, wood, material, shear) Timing of high, low flow
Morphology	Growth form (eg. herbaceous-woody, graminoid-shrub-tree) Root morphology (lateral-taproot, shallow-deep) Size at maturity (canopy height, vegetation volume)	Flow duration Magnitude and duration of low and high flow Water table depth and inter- and intra-annual variability Flow permanence, groundwater depth, flow variability.
Fluvial disturbance	Furrowed bark Flexible stems Resprouting ability Adventitious roots and stems (scour-burial)	Magnitude and frequency of high flow High sediment flux
Water balance	Stomata control Critical water stress level- xylem water pressure potential Aerenchyma (tolerance of anoxia) Oxygen diffusion to roots Drought -induced dormancy Tolerance of submergence Rate of root extension	Magnitude/duration of low flow Magnitude/duration of low flow Duration of high flow Water table depth and inter- and intra-annual variability Rate of stage decline.

B. Existing riparian vegetation at cross sections

The photos below show the existing riparian vegetation at the selected cross sections. Basically, all riverbanks where there is a resemblance of a flood plain have been cultivated with Eucalyptus trees, sugarcane, coffee, bananas, and rice. It is therefore not possible to evaluate riparian vegetation requirements basing on the existing riparian vegetation. In this study therefore flow requirements for riparian vegetation were based on historical knowledge of the ecologists.

Photo 5-51 *Riparian vegetation at cross section 14*

Photo 5-52*: Riparian vegetation at cross section 13*

Photo 5-53*: Riparian vegetation at cross section 12*

Photo 5-54*: Riparian vegetation at cross section 10*

Photo 5-55*: Riparian vegetation at cross section 09*

Photo 5-56*: Riparian vegetation at cross section 07*

Photo 5-57*: Riparian vegetation at cross section 08*

Photo 5-58*: Riparian vegetation at cross section 11*

Photo 5-59*: Riparian vegetation at cross section 06*

Photo 5-60 *Riparian vegetation at cross section 04*

Photo 5-61*: Riparian vegetation near cross section 01*

Photo 5-62*: Riparian vegetation near cross section 02*

Photo 5-63*: Riparian vegetation at cross section 03*

Photo 5-64 *Riparian vegetation at cross section 05*

C. Vegetation guild results at cross sections

The riparian vegetation is predominantly comprised of sedges, rushes and reeds growing in the flood plains. Riparian vegetation on flood plains was the focus at cross section 10, cross section 09, cross section 07, cross section 08, cross section 06, cross section 04 and cross section 01. The section of the river under study had no functional wetland and all flood plains were cultivated with sugarcane, eucalyptus trees and others were being used for grazing. These are perennial in nature. At closer look at the flood plains, it was evident that their source of water on an annual basis was based on pluvial flooding and direct rainfall rather than fluvial flooding. For that reason, consideration for flow from the river was only considered under large floods. Flows of interest for the riparian vegetation is the same as that required for channel formation and they were discussed in more detail under channel forming flows.

5.7.6 Fish

Because fish assemblages often include a range of species that represent a variety of trophic (feeding) types (i.e., omnivores, herbivores, insectivores, piscivores), they reflect the integrated effects of environmental changes. Their presence, therefore, can also be used to infer the presence of other aquatic organisms, since the adults occupy the top of the food chain in most aquatic systems. They also pass through most trophic levels above the primary producer stage during their development from larvae to adults. Fish assemblage structure can thus be regarded as reflecting the integrated environmental health of a river. If the species richness in a river is sufficiently high and the structure of the fish assemblage is sufficiently diverse, then knowledge of the environmental conditions needed by fish to complete their life cycles can contribute greatly to an understanding of the functioning of that river. It can also guide specification of the flows necessary to meet their needs and be useful in the monitoring and management of those flows. In general, it is also often surmised that if management of flows for fish maintenance is successful, then flow requirements for aquatic invertebrates will also be satisfied (King et al., 2008).

Information that was available on the ecological, flow-related requirements of various life history stages of different fish species was used in this study to guide recommendations for required future flows in the river. Presents the detail requirements of instream flow for the fish species found in the river based on the relevant IFR sites. Table 5-66: converts these requirements into discharges required at the IFR sites.

Table 5-67: Details of instream flow requirements for fish at the relevant cross sections

Sampling Point/ Cross sections	Substrate	Fish Species	Notes on the fish species	Recommended duration for maintenance	Minimum possible period	Optimal Water depth required	Maintenance Water Depth	Minimum Water Depth
Sites 1, 2, 3, 4 & 5	Sandy and rocky bottoms with large cobbles on the bedrock but also found along vegetated fringes of large rivers. Adults prefer large woody debris, root masses and emergent vegetation	*Enteromius kersternii*	Found in fast flowing, sluggish, and temporary streams. Feeds on insects, debris, molluscs, plant material, seeds and algae Spawns between Oct -Mar and he cues is increased flows thus, Breeds in flood plains during rains Migrates upstream or laterally when rain comes.		This shall focus on both the minimal and predicted highest flows of the river. Velocity is 0 – 0.1 (0.5 m/s) and the max velocity 1.6 m/s	>0.4m depth depending on the overall depth of the streams and rivers	Depth range is 0.2 – 0.3 (0.6 m)	0.07 for Juveniles
Site 1 & 5	Muddy, sand and silty bottom. Vegetative littoral zones of deep waters. Small cobbles, leaf litter and macrophytes, rocky undercuts, small woody debris, and submerged vegetation.	*Clarias gariepinus*	Benthpelagic, inhabiting waters just above the muddy bottom and in marginal vegetation. Lateral and upstream migration happens for breeding. It breeds in stream which flow into the lake during the rainy season (March – May and Sept - Nov).	It is important to note that this fish will require higher flow during the spawning periods since it synchronizes its spawning with the raining seasons.	Velocity is low to moderate 0.15 – 0.6m/s since its more of a lentic fish). Max velocity is 0.8m/s for juveniles and 1.36m/s for adults.		0.3 – 1-7 (2.5 m in large pools)	This fish can survive in any water depth, since it is able to survive in wetlands and ponds >0.5m depth for adults

Sampling Point/ Cross sections	Substrate	Fish Species	Notes on the fish species	Recommended duration for maintenance	Minimum possible period	Optimal Water depth required	Maintenance Water Depth	Minimum Water Depth
	Juveniles prefer muddy bottoms		The eggs are attached by an adhesive disc to plants and debris in the bottom of the stream. The young hatch within 36 hours after fertilization and might remain in the stream for about six weeks before they swim to the main lake. However, during the first year, they young reappear in the streams whenever connected to the lake. Its Omnivorous with fish, insect larvae, molluscs and plant material Juveniles (< 5 cm total length) feed mainly on insect larvae					Juveniles need at least 0.1m
Site 1	Muddy, sand and silty bottom. Vegetative littoral zones of deep waters	*Clarias liocephalus*	Demersal, inhabiting vegetated areas of rivers and wetlands. Feeding: Principally insectivorous, although					

Sampling Point/ Cross sections	Substrate	Fish Species	Notes on the fish species	Recommended duration for maintenance	Minimum possible period	Optimal Water depth required	Maintenance Water Depth	Minimum Water Depth
			larger individuals are piscivorous					
Site 1 & 2	Large rocks, boulders, gravel or mixed cobble and bedrock substrates.	*Amphilius jacksonii*	A rheophilic species, inhabiting well oxygenated streams with moderate to fast flowing current Spawns between June – October during increased flows (rainy season). Feeding: benthic aquatic insects mainly the Trichoptera, Ephemeroptera and Diptera groups)		Velocity is 0.6-0.8m/s and sometimes 1.2m/s for adults, while juveniles prefer 0.1 -0.8 m/s	>0.5m	0.15m – 0.6m for both juveniles and adults	0.15 m

Table 5-68 This table converts the instream flow requirements into the associated discharges at the IFR sites

Site	Species	Optimal Depth [m]	Velocity [m/s]	Maintenance Depth [m]	Depth derived flow[m3/s]	Velocity derived flow [m3/s]	Maintenance flow [m3/s]
Site 1	*Enteromius kersternii*	0.4	0.1-1.6	0.2	0.55	0.09-1.46	0.28
	Clarias gariepinus		0.15-1.36	0.3		0.14-6.72	0.41
	Clarias liocephalus		0.15-1.36	0.3		0.14-6.72	0.41
	Amphilius jacksonii	0.5	0.1-0.8	0.15-0.6	0.69	0.09-0.73	0.21

Site 2	*Enteromius kersternii*	0.4	0.1-1.6	0.2	1.26	0.08-9.46	0.44
	Amphilius jacksonii	0.5	0.1-0.8	0.15-0.6	1.79	0.08-1.29	.33
Site 3	*Enteromius kersternii*	0.4	0.1-1.6	0.2	1.95	0.09-10.75	0.54
Site 4	*Enteromius kersternii*	0.4	0.1-1.6	0.2	0.97	0.09-7.09	0.44
Site 5	*Enteromius kersternii*	0.4	0.1-1.6	0.2	1.62	0.12-5.59	0.38
	Clarias gariepinus		0.15-0.8	0.3		0.18-1.10	0.56

Maintenance flows

The discharges at different cross sections for the maintenance of fish species are provided in Table 5-61 provides the contribution to flow from the catchment area between the reservoir and the associated IFR site. From this information, the required releases from the reservoir were calculated as presented in Table 5-63.

Table 5-69: Instream Flow Requirements (IFR) at different cross sections for fish species at maintenance level.

Month/ Cross section	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Section 01	0.41	0.47	0.46	0.56	0.58	0.45	0.41	0.46	0.63	0.67	0.65	0.50
Section 02	0.44	0.50	0.49	0.60	0.62	0.48	0.44	0.49	0.67	0.72	0.70	0.54
Section 03	0.53	0.61	0.59	0.72	0.75	0.58	0.53	0.59	0.81	0.86	0.84	0.65
Section 04	0.44	0.50	0.49	0.60	0.62	0.48	0.44	0.49	0.67	0.72	0.70	0.54
Section 05	0.38	0.44	0.42	0.52	0.54	0.42	0.38	0.42	0.58	0.62	0.60	0.46

Table 5-70: Contribution from the catchment between the dam and the relevant section

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Section 02	0.65	0.75	0.73	0.89	0.92	0.72	0.65	0.73	1.00	1.06	1.04	0.80
Section 03	0.42	0.48	0.46	0.56	0.59	0.46	0.41	0.46	0.64	0.68	0.66	0.51
Section 05	0.32	0.37	0.36	0.44	0.46	0.36	0.32	0.36	0.50	0.53	0.51	0.40

Table 5-71: Required releases from the reservoir for maintenance of fish

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Section 02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Section 03	0.11	0.13	0.13	0.16	0.16	0.13	0.11	0.13	0.17	0.19	0.18	0.14
Section 05	0.06	0.06	0.06	0.08	0.08	0.06	0.06	0.06	0.09	0.09	0.09	0.07

Optimization of fish production

Under these circumstances, the study is looking at the optimal water requirements at the IFR sites given the optimal conditions needed for the fish to survive in the best water related environment. The tables above present the IFR discharge requirements at the relevant IFR sites, flow that is contributed by the catchment between the IFR site and the dam and the releases required from the reservoir by each IFR site.

Table 5-72: Instream flow requirements for the optimization of fish conditions at the IFR sites

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Section 01	0.55	0.63	0.61	0.75	0.78	0.60	0.55	0.61	0.84	0.90	0.87	0.67
Section 02	1.79	2.05	1.99	2.43	2.53	1.96	1.78	2.00	2.74	2.91	2.84	2.19
Section 03	1.95	2.23	2.17	2.65	2.76	2.14	1.94	2.18	2.99	3.17	3.09	2.38
Section 04	0.97	1.11	1.08	1.32	1.37	1.06	0.96	1.08	1.49	1.58	1.54	1.18
Section 05	1.62	1.85	1.80	2.20	2.29	1.78	1.61	1.81	2.48	2.64	2.57	1.98

Table 5-73: Contribution to flow by the intervening catchment between the IFR site and the dam

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Section 02	0.65	0.75	0.73	0.89	0.92	0.72	0.65	0.73	1.00	1.06	1.04	0.80
Section 03	0.42	0.48	0.46	0.56	0.59	0.46	0.41	0.46	0.64	0.68	0.66	0.51
Section 05	0.32	0.37	0.36	0.44	0.46	0.36	0.32	0.36	0.50	0.53	0.51	0.40

Table 5-74: Required releases from the reservoir as per the requirements of each IFR site.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Section 02	1.14	1.30	1.26	1.54	1.61	1.25	1.13	1.27	1.74	1.85	1.80	1.39
Section 03	1.53	1.76	1.70	2.08	2.17	1.68	1.52	1.71	2.35	2.50	2.43	1.87
Section 05	1.30	1.48	1.44	1.76	1.83	1.42	1.29	1.45	1.98	2.11	2.06	1.58

5.7.7 Livestock water demand

The livestock water demand was computed, based on the projected UBOS's 2008 livestock census, by summing the water demands for all livestock types (i.e., cattle, goats, sheep, pigs and poultry) for the catchments around Matanda Irrigation scheme, MoWE (2022). The demand was projected to the future years up to 2040 as indicated in the table below.

Flow / Year	**2022**	**2027**	**2032**	**2037**	**2040**
m^3/year	739,282	741,561	744,237	747,375	749,511
m^3/sec	0.023	0.024	0.024	0.024	0.024

Analysing the water requirements for the aquatic life and the proposed water preserved for the environmental flow, there is sufficient water left in the river to supply the estimated future water demand for livestock as part of the environmental flow.

5.7.8 Setting the environment flow requirement and scenarios

Two sets of environment flow releases from the reservoir were compiled based on the two different environmental management targets for fish as it was observed that important riparian vegetation would not be significantly impacted by the flow variations in the river. The management scenarios were (i) maintenance, and (ii) Optimal fish environment. Another set of environmental flow proposed in the design was added to create three initial scenarios. After the establishment of the environmental flow releases, an interactive process of determining the impact on the yield and making any adjustments was undertaken. The required yield was calculated and the impact of the EFRs on the yield was evaluated. If the yield could be met with the proposed EFRs in place, the assessment would be terminated. If the EFT cannot be met without impact on the proposed development, then a compilation of an appropriate range of scenarios by changing either the magnitude, frequency or duration of various flow components, or the assurance of these flows would be made. The decision was done based on knowledge of the predicted engineering, financial and social costs, and the ecological implications for river condition.

Table 5-75: Maintenance Flows

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flow [m^3/s]	0.11	0.13	0.13	0.16	0.16	0.13	0.11	0.13	0.17	0.19	0.18	0.14
FDC %	100	100	100	100	100	100	100	100	100	100	100	100

Table 5-76: Optimal fish condition flows

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flow [m^3/s]	1.53	1.76	1.70	2.08	2.17	1.68	1.52	1.71	2.35	2.50	2.43	1.87
FDC %	28	23	27	29	26	28	30	31	26	30	30	32

Table 5-77: Engineering design flows

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flow [m^3/s]	0.42	0.47	0.42	0.44	0.42	0.44	0.42	0.42	0.44	0.42	0.44	0.42
FDC %	100	48	100	100	100	50	100	100	100	100	100	100

5.7.9 Recommended Environmental Flow regime

From the different flow regimes proposed above, the flow requirements for optimal survival of fish are very high and not normally met under the natural flow regime. These types of flows are experienced on average just 30% of the time. On the other hand, flows required for the maintenance of fish are experienced almost 100% of the time and therefore can easily be achieved. However, it shall be noted that these flows are very restrictive in that they provide the minimal conditions necessary for the survival of the fish. The proposed regime used by the design team provide better conditions as compared to fish survival and therefore other related flora and fauna. However, this regime does not provide for channel maintenance flows. It is therefore recommended that the release from the reservoir follow a combination of the design release flows in conjunction with the channel maintenance flows. The recommended releases at the reservoir are as presented in Table 5-70.

Table 5-78: Recommended reservoir releases in cubic meters per second for environmental flow.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flow [m^3/s]	0.42	0.47	0.42	0.44	0.42	0.44	0.42	0.42	0.44	0.42	0.44	0.42
FDC %	100	48	100	100	100	50	100	100	100	100	100	100
Small Flood peak [cumecs]	13											
Small Flood duration [days]	5											
Small Flood timing [Julian days]	289											
Small Flood freq. [No per yr]	Once every two years											
Small Flood rise rate [Δdisch/day]	5.7cumecs/day											
Small Flood fall rate [Δdisch/day]	-4.7/cumecs/day											

5.7.10 Groundwater vulnerability

Ground water vulnerability analysis was conducted using the DRASTIC technique. The technique developed by the Environmental Protection Agency (EPA) assumes that: (i) Contamination occurs at the ground surface; (ii) The contamination enters the table when rain falls on the surface and percolates into the saturated zone; (iii) The contaminant travels with water at the same rate as water.

	Factor	Weight
D	Depth to top of the Aquifer	5
R	Net Recharge	4
A	Aquifer Media	3
S	Soil Media	2
T	Topography	1
I	Impact of Vadose Zone	5
C	Hydraulic Conductivity of the Aquifer	3

The method produces a Drastic Index based on the rankings of hydrological, geological and hydro-geological characteristics of the area. The parameters ranked include: (i) Depth to ground water (D); (ii) Net Recharge (R); (iii) Aquifer media (A); (iv) Soil media (S); (v) Topography (T); (vi) Impact of the vadose zone (I), and (vii) The hydraulic conductivity of the aquifer (C).

Each parameter is assigned a relative weight from one to five based on its relative susceptibility to pollutants as in the table above:

Similarly, parameter rankings are assigned on a scale of one to ten and are based on its significance to pollution potential in the assessed area. The set of variables considered can be grouped according to three main categories: land surface factors, unsaturated zone factors and aquifer or saturated zone factors. The aquifer properties and the hydraulic conductivity are the critical factors identified for the saturated zone. The depth to water and the properties of the vadose zone characterizes the water/contaminant path down to the saturated zone. In soil and the unsaturated zone, some mechanisms may affect the contaminant concentration much more than in the saturated zone. Typical ranges and ratings are provided below.

The DRASTIC index[4] is computed by summing the weighted factors of each subdivision of the area as:
Drastic Index = $D_rD_w + R_rR_w + A_rA_w + S_rS_w + T_rT_w + I_rI_w + C_rC_w$

Table 5-79:Typical ranges and ratings for D, R and A

Depth to Water (ft)		Net recharge (inch)		Aquifer media		
Range	Rating	Range	Rating	Type	Rating	Typical rating
0-5	10	0-2	1	Massive shale	1-3	2
5-15	9	2-4	3	Metamorphic/igneous rocks	2-5	3
15-30	7	4-7	6	Weathered metamorphic/igneous	3-5	4
30-50	5	7-10	8	Thin bedded sandstone, limestone, shale sequence	5-9	6
50-100	2	>10	9	Massive sandstone	4-9	6
>100	1			Massive limestone	4-9	6

Table 5-80: Typical ranges and ratings for S, T, I, and C

Soil media		Topography (percent slope)		Hydraulic Cond. (GPD/ft2)	
Range	Rating	Rate	Rating	Range	Rating
Thin or absent	10	0-2	10	1-100	1
Gravel	10	2-6	9	100-300	2
Sand	9	6-12	5	300-700	4
Peat Clay	8	12-18	3	700-1000	6
Shrinking or aggregated clay	7	>18	1	1000-2000	8
Sandy loam	6			>2000	10
Loam	5				
Silt loam	4				
Clay loam	3				
Humus	2				

[4] Hisiniaina, F., Zhou, J., Guoyi, L., (2010). Regional assessment of groundwater vulnerability in Tamtsag basin, Mongolia using DRASTIC model. Journal of American Science 2010:6(11).

Non-shrinking & non-aggregated clay	1				

Table 5-81: *Typical score ranges for the Vandose zone media based on media composition*

Vandose Zone media		
Range	Rating	Typical rating
Silt, clay	2-6	3
Shale	2-5	3
Limestone	2-7	6
Sandstone	4-8	6
Bedded limestone, sandstone, shale	4-8	6
Sand & gravel with significant silt and clay	4-8	6
Metamorphic/igneous	2-8	4
Sand and gravel	6-9	8
Basalt	2-10	9
Karst limestone	8-10	10

Results of the drastic index calculation are presented in the Table 5-82 below.

Table 5-82: *Weighted scores and their summation based on the Drastic index*

Parameter	Result	Weight	Product
D	2	5	10
R	3	4	12
A	3	3	9
S	3	2	6
T	9	1	9
V	3	5	15
H	6	3	18
Total			**79**

According to the results from the analysis, the drastic index is 79. It can therefore be concluded that the risk of irrigation water contaminating groundwater is very low.

STAKEHOLDER CONSULTATIONS

6 STAKEHOLDER CONSULTATIONS

6.1 Introduction

This section presents the objectives, process and the outcomes of the stakeholder involvement in the process of this ESIA. Emphasis has been placed on an inclusive, open and transparent public participation process and the transfer of information regarding the proposed irrigation scheme to interested and affected persons (I&APs). The provision of sufficient and useful information on an on-going basis to I&APs to allow them to participate in the project and offer comments is a cornerstone of this ESIA process.

The ESIA process started with a scoping exercise aimed at identifying relevant issues to form the focus of the ESIA study and refine the terms of reference provided by the project proponent. This chapter presents the results of stakeholder engagement activities undertaken from May 2018 to March 2023, during the ESIA study but also the key consultation undertaken in the month of September 2023 in the updated stakeholder engagement. 26 consultation events were held including the Batwa communities covering both the earlier studies of 2019 and the updated version of 2023. 180 males and 120 females formed the consultative engagements.

6.2 Objectives of consultation and disclosure

Stakeholder consultation aimed to achieve the following:

i. Update stakeholders on the progress of ESIA studies and additional areas on command area.
ii. Generate a good understanding of the project.
iii. Understand people and agency expectations about the project (from construction through to operation of the scheme).
iv. Understand and characterize potential environmental and socio-economic impacts of the scheme.
v. Enhance local benefits from the irrigation scheme.
vi. Enable affected communities to provide views hence participating in or refining project design, where applicable.

6.3 Standards for consultation

The public consultation was guided by Ugandan guidelines summarized in Box 8-1.

Box 8-1: Uganda Guidelines Relating to Public Consultation.

Although no regulations exist for public consultation, national guidelines for ESIA in Uganda require that the public is given full opportunity for involvement and participation throughout the ESIA process. People including individuals, or groups of local communities who may be directly affected by a proposed project shall be a focus for public involvement.

Since identification of the "public" likely to be indirectly affected by the proposed activity is often more difficult, it is required to exercise care in deciding who participates to ensure that a fair and balanced representation of views is obtained, and views of minority groups are not overshadowed by more influential members of the public.

The public may appropriately be involved in the ESIA process through:

i. Informing them about the proposed project.
ii. Participation in scoping exercise.
iii. Open public meetings/hearings on the project.
iv. Inviting written comments on proposed project.
v. Use of community representatives.
vi. Comment and review of the Environment and Social Impact Statements; and,
vii. Making relevant documents available to any interested members of the public in specified places or at the cost of reproduction.

Three stages for public involvement in the ESIA process are spelt out:

a) **Public consultation before ESIA is done**

If after receiving and screening/reviewing the developer's project brief, the Authority (NEMA), in consultation with the Lead Agency, decides that it is necessary to consult and seek public comment, it shall, within four weeks from submission of the project brief and/or notice of intent to develop, publish the developer's notification and other supporting documents or their summary in a public media. It is required that objections and comments from the public and other stakeholders shall be submitted to the Authority and to the Lead Agency within 21 days from the publication of notice.

b) **Public consultation during the ESIA**

The team conducting the ESIA shall consult and seek public opinion/views on social and environmental aspects of the project. Such public involvement shall be during scoping and any other appropriate stages during the conduct of the study.

c) **Public consultation after ESIA (ESIA Review)**

The ESIA shall be a public document and may be inspected at any reasonable time by any person. Considering the scale and level of influences likely to result from the operation of a project, the Authority, in consultation with the lead agency, shall decide regions where it is necessary to display the ESIA report to the general public.

Information disclosed includes details of the purpose, nature, location, the project benefits and adverse impacts, as well as the proposed enhancement and mitigation measures and duration of project activities. In this context, meetings were held at District and Community levels during inception, scoping and detailed study phases. A summary of the key findings from the consultation process have also been presented in this section while a detailed transcription of the meetings (minutes) is provided in Appendix C.

6.3.1 Stakeholders consulted

Several stakeholder consultations were held in the proposed project area to collect their views and concerns. Table 6-2 presents the identified District and Subcounty/Town council level stakeholders that were consulted during the earlier consultations in 2019 before the extension of the project area command and Table 6-1 represent the consultations done after the extension of the project area command.

Table 6-1: Local administration consulted stakeholders for proposed command area before the extension.

Stakeholder	Participants		Date
	Name	Position / Title	
Kanungu District	Mutahakana Gertrude	PAS	07.02.2019
	Atuhaire innocent		
	Maj. Bob Turyagenda	Owc Coordinator	
	Byamukama Mathias	Senior Agricultural Officer	
	Politique J.B Emmanuel	Senior Agricultural Engineer	
	Shafiq Sekanzi	RDC Kanungu	
	Turiyo Peter	Production Coordinator	
	Tumusiime Dabtience	Senior Labour Officer	
	Kobusheshe	D/DISO Kanungu	
Nyamirama Subcounty	Asiimwe Emmanuel	Agricultural officer	07.02.2019
	Tumwesigye Paul	CDO	08.08.2019
	Kabyesima James	LCIII Chairperson	
	Akampurira Godwin	Parish chief	
Kihihi Subcounty	Godly Kyenoel	LCIII Chairperson	07.02.2019
	Arineitwe Amon	Finance Secretary	
	Asiimwe Abia	Parish Chief	
	Natukunda Nelson	LCIII Chairperson	
Kihihi Town Council	Mayanja Rashid	LCII Chairperson	10.08.2019
	Nsaba Benon	S/C Mobilizer	
	Musinguzi Moses	Area councillor	
	Niragire Vincent	Bihomborwa Ward Mobilizer	
Nyakinoni	Kabandize Gad Akanshumbusha	Subcounty Mobilizer	08.08.2019
	Twesigye Silver	Karubeize Mobilizer	
	Habasa Salvani	Samaria Mobilizer	
Nyanga	Bikoryomuhangi John	Subcounty mobilizer	09.08.2019
	Mpozembizi Anna Maria	Nyanga parish Mobilizer	
	Nirere Jane	Nkunda parish mobilizer	
Kanyantorogo	Mwesigye Kenneth	SAS	09.08.2019
	Tumuhamye Keneth	LCIII Chairperson	
	Asiimwe Mariam	District Councilor	

Table 6-2: Local administration consulted stakeholder for proposed Matanda during ESIA update

Stakeholder	Participants		Date
	Name	Position / Title	
Kanungu District	Kwasibwe Godwin	DPO	10.08.2023
	Tumusiime Dabtiance	Officeof RDC	
	Magara Deus	Sec-Production	
	Atuhaire Innocent	D/ Planner	
	Kwesiga Confidence		
	Muwerezi Gerald	Sociologist	
	Turiyo Peter	Production Coordinator	
	Kobusheshe	D/DISO Kanungu	
Kihihi Subcounty	Ebwoga Tonny	Subcounty leader	09.08.2023
	Nyeega M Joseph	Producation	
	Asiimwe Abia	Parish Chief	
	Natukunda Nelson	LCIII Chairperson	
	Omwesigye Levison	Subcounty leader	
	Arweitwe Vara	Rwerere chairperson	
	Mugisha Milton	Rwerere parish	
Nyanga Subcounty	Yunuukuzi Ezra	LCIII Chairperson	09.08.2023
	Tugume Moses Lamah	CDO	
	Asiimwe Emmanuel	Area councillor	
	Kagoriro Moses	Bukwe Chairperson	

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Photo 6-1 Updated meeting with Kanungu District planner.

Photo 6-2 update meeting with Nyanga Subcounty leaders.

Photo 6-3 Meeting with chairpersons of six villages

Photo 6-4 Community meeting in Bukorwe Village

Photo 6-5 Kanungu District

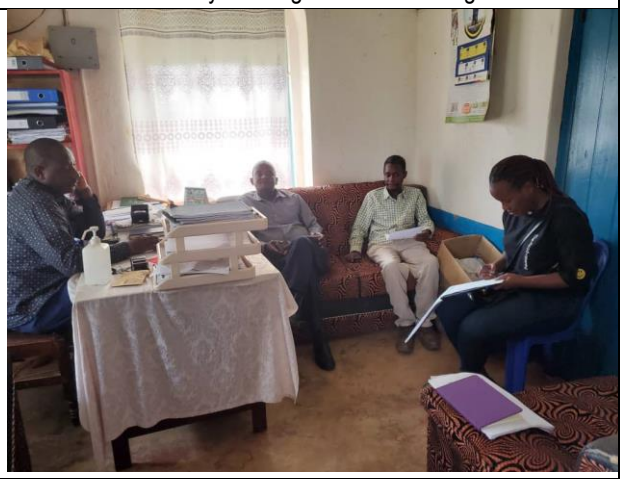


Photo 6-6 Kihihi Subcounty

Key issues emerged from the engagements

During these stakeholder engagements, stakeholders raised a number of concerns regarding project implementation. Table 6-3 elaborates issues raised during the updated consultation and engagement.

Table 6-3: Key emerging issues from the stakeholders consulted

Stakeholder	Key concern	Recommendations
Kanungu District (01.11.2018), (07.02.2019) & (10.08.2023)	Land acquisition	Agricultural land, property and crops affected due to construction of project infrastructure especially the distribution channels or pipes shall be fairly and promptly compensated for.
	Employment expectations & Local content	The contractor shall give first priority to the able persons from the local communities when recruiting especially for casual labour. This will promote project ownership in the community and overall improved cooperation between the contractor and the community.
	Waste management	The contractor shall have a waste management plan and ensure proper collection, storage, transportation and disposal of waste in a sanitary manner.
	HIV/AIDS	Workers and communities shall be sensitized on HIV/AIDS. Free testing and counseling campaigns shall be held for workers and the communities.
	Impact on Physical Cultural Resources	Cultural features e.g., the Banyabutumbi tree and graves shall not be destroyed during construction of the scheme. Where inevitable, the owners and local leaders shall be consulted on the procedure and requirements for relocation.
	Wildlife-human interaction	There is also need to consultant on the wildlife authority to ascertain the relationship between the project and wildlife.
	Project delays	The project needs to be fast-tracked. It has taken so long, and communities are getting fatigued over the project.
	Water source protection	Water sources shall be protected throughout the project implementation.
	Community involvement	Communities need to be reoriented about the project. It is equally important that the consultant also visit the sub counties and notify them about the updated studies.
Sub County/Town council stakeholders Nyamirama (07.02.2019 & 08.08.2019) Kihihi (07.02.2019) & (09.08.2023) Kihihi Town Council (10.08.2019) Nyakinoni (08.08.2019) Nyanga (09.08.2019)	Employment	During recruitment of workers, first priority shall be given to the local communities within the command area to promote project ownership and ensure its sustainability.
	Compensation for affected property	Property affected due to construction of the scheme shall be compensated for in a transparent and timely manner.
	Labour force management	The contractor shall have a plan to manage his workers and shall put in place strict rules against crime. He/she shall ensure that all workers are given identity cards and are also registered and known to the LC1 leaders of the respective areas of their operation.

Stakeholder	Key concern	Recommendations
Kanyantorogoing (09.08.2019)	Increase in Promiscuity, Destruction of families and Marriages	The contractor shall have a very strict employment code of conduct which prohibits sexual relationships with married women and underage girls and shall also conduct massive sensitization of both the workers and members of public within the affected communities to make create awareness of the dangers involved in engaging themselves in extramarital relationships. Need to safeguard against domestic violence in the project area during implementation.
	Conservation	Need for full-fledged biodiversity person to study biodiversity issues in the project area.
	Employment	Employment of the community members shall be emphasized during project implementation.
	Training and Capacity building	Training in irrigation-based farming practices need to be passed on the farmers in order to benefit from the project.
	Project delays	There is a general community fatigue about the project. Endless meetings occurred with less implementation on the ground.
Community (15.11.2019-23.11.2019) & (9.-11.8.2023)	Employment	Priority, especially of unskilled and semi-skilled labour shall be given to local communities in the command area.
	Land acquisition and compensation issues	All affected property will be compensated for. The valuation and compensation exercise shall be transparent and shall involve local leaders and representatives of affected persons.
	Impact on water sources	Water sources especially bore holes that may be affected as a result of project works shall be reconstructed or the project shall provide alternative sources of water for the community.
	Cultural site	The project shall ensure that cultural sites and features are preserved during construction. In cases where they cannot be avoided, the developer shall consult the communities and caretakers of such sites to ensure right procedures are followed in relocating them.
	Social ills such as family breakage, defilement, rape, theft among others	If possible, foreign workers shall come with their wives to avoid engaging in sexual relations with married women/men and school going children. Additionally, the contractor shall have strict rules that prohibit such interactions. The community raised concerns regarding influx of workers from other parts of the country which may cause tension in the communities since they usually do not move with their families. This may push them into engaging in sexual relations with married people hence breaking their marriages or escalating domestic violence, sexual abuse of school children hence increasing the number of school dropouts and early and unwanted pregnancies.
	Project delays	Need to FastTrack the project. The project has taken a period of over 5 years with less success.
	Project extents	Requested that the irrigation schemes be on a large scale to benefit the communities financially.

Stakeholder	Key concern	Recommendations
	Land issues	A common concern raised in all meetings was regarding property e.g. land, buildings, crops etc. that will be affected during construction of the irrigation scheme infrastructure; whether the loss will be compensated for and whether compensation will be adequate, fair and property owners paid before construction commences.
UWA (06.03.2023)	Biodiversity Team	The consultant's team shall be composed of a full-fledged biodiversity team
	Anthropogenic activities	All anthropogenic activities along River Kiruruma in the project area shall be captured and documented
	Wildlife-human interaction	Electric fence along the park and project area is a good suggestion, however in reference to the death of lion case, UWA demands that a separate ESIA must be conducted for any intended electric fence project. **Note:** There is an existing trench at the Kigezi Wildlife side currently deterring elephant crop raiding. The trench has been in existence for decades and is maintained by the community with support from UCF and WCS. UWA has a plan (still at proposal stage) to fence off Ishaha side (the same area near the project) with an electric fence.

Table 6-4: Emerging issues from District stakeholders during the studies

No	Issue	Stakeholder views	Response by the consultant	Consideration by Project
1	Land acquisition	Agricultural land, property and crops affected due to construction of project infrastructure especially the distribution channels shall be fairly and promptly compensated.	The project developer (MWE) is committed to ensuring timely, adequate and fair compensation to persons whose property would be affected by the project. A Resettlement Action Plan (RAP) will be prepared to guide land acquisition and compensation will be done according to national laws (The Constitution and Land Act) through a private valuer, as is the law, and overseen by local leaders.	A Resettlement Action Plan (RAP) will be prepared and compensation of affected persons will be done by MWE before commencement of the project.
2	Employment expectations & Local content	A concern was raised regarding construction contractors who usually bring in workers from other parts of the country and only offer to recruit very few people from the community. It is therefore important that the contractor gives first priority to the able persons from the local communities when recruiting, especially for casual labour. This will promote project ownership in the community and overall improved cooperation between the contractor and the community.	The contractor shall be required to employ persons from the local community. However, this will largely depend on the jobs available and skills possessed by the people within the command area. The contractor shall be required to ensure that information regarding job availability is made available to the community through appropriate channels. He/she shall be also required to involve local leaders especially LC1s in the recruitment process to sieve out persons with criminal records.	A Labour Management Plan shall be developed and implemented by the contractor.
3	Child labour	Much as officials encouraged employment of the local people, they raised a concern that, if there is poor remuneration, most of the adult people may not be willing to take up casual jobs on the project. This could potentially result into recruitment of children to provide labour on the project.	Child labour is condemned by Ugandan laws as well as all international conventional instruments such as International Labour Organization (ILO) and the United Nations (UN). The contractor will work with the Police and the local leadership in the project area to ensure that children under the age of 18 are not recruited for employment on the project. The contractor shall always recruit in consultation with the local leadership. In addition, recommendation letters from parents or guardians shall be sought before one is employed.	A child protection policy shall be developed and implemented by the contractor.
4	Waste management	A concern was raised regarding generation of waste during construction which if not handled properly will turn into a nuisance to community and may contaminate water sources.	The contractor shall put in place a system of managing waste, including the procurement of services of licensed waste handlers to manage waste generated at the worker's camp and all construction sites. The contractor shall prepare a waste management plan that will detail	A waste management plan shall be developed and implemented by the contractor.

No	Issue	Stakeholder views	Response by the consultant	Consideration by Project
			procedure for collection, storage, transportation and disposal of waste in a sanitary manner.	
5	Stakeholder engagements	Officials pointed out the need to also consult communities in the command area, not only during the ESIA studies, but also when the construction starts. This will increase project awareness and enhance ownership and participation of the community in project activities.	With the help of the Community Development Officers and local leaders of the respective sub counties within the command area, the consultant has drawn up a program of community consultation to ensure project disclosure and collection of views and suggestions of the people regarding anticipated impacts and how best they can be mitigated during construction and operation of the scheme. The contractor, through his/her sociologist and community liaison officers, will be required to continuously engage communities during construction. This will be helpful in enhancing project-community relations and aid grievance redress.	Stakeholder engagement plan shall be developed and implemented by implementing parties including MWE and the contractor.
6	HIV/AIDS	Officials also identified the potential of the project to increase HIV/AIDS. It is feared that unaccompanied construction workers might exploit the women and underage girls in the community due to high poverty levels in the area especially during the dry seasons that affect agricultural yield and income. The resultant sexual unions may end up escalating HIV/AIDS and STIs in the project area.	Workers and communities will be sensitized on the potential of the project to increase HIV/AIDS. The project shall include in its design a program of awareness and control of the spread of HIV/AIDS and other diseases such as malaria, TB and diarrhea.	A HIV/AIDS policy shall be developed by the contractor. A Nominated Service Provider shall be procured to undertake all HIV/AIDS prevention related activities among workers and project communities.
7	Impact on physical Cultural Resources	Of concern during consultations was the likely impact of construction works on cultural resources within the command area e.g., the Banyabutumbi tree to which the local community has cultural attachment and graves. In the event that these are affected, the affected persons and respective leaders shall be engaged to advice on how relocation of these can best be done.	The project will try as much as possible to avoid the cultural sites and, in the event, that they can't be avoided, the owners and local leaders will be consulted on the procedure and requirements for relocation.	A chance finds procedure has been included in the report to be followed in case of any chance findings.

6.3.2 Stakeholders consulted at community level

At community level the consultant aimed focusing more on the chairpersons and community members within the command area. The engagement included focus group discussions but also at the household level during household data collection. Key issues raised during the engagement at the community level are elaborated in Table 6-5.

Table 6-5:Community level consulted stakeholder study summarized minutes

No	Issue	Concern	Response by the consultant	Consideration by the project
1	Employment	During engagements, community raised a concern regarding importation of workers from other parts of the country to do jobs that even the locals can execute for especially Casual labour. They therefore requested that priority for such work be given to local communities in the command area.	The contractor will be required to incorporate local content during employee recruitment. Information regarding Jobs available and skills required will be made available to the public through community notice boards, meetings, Radio stations and any other appropriate media. Guidance will be given to community on how to apply.	A Labour Fource Management Plan shall be developed and implemented by the contractor.
2	Land acquisition and compensation issues	A common concern raised in all meetings was regarding property e.g., land, buildings, crops etc. that will be affected during construction of the irrigation scheme infrastructure; whether the loss will be compensated for and whether compensation will be adequate, fair and property owners paid before construction commences.	All affected property will be compensated for. A Resettlement Action Plan will be prepared detailing eligible property and procedure for land acquisition.	A Resettlement Action Plan (RAP) will be prepared and compensation of affected persons will be done by MWE before commencement of the project.
3	Impact on water sources	The community was concerned about water sources especially boreholes that will be affected by the scheme infrastructure especially the distribution channels.	Water sources especially bore holes that will be affected as a result of project works will be reconstructed by the developer in an appropriate location.	A water resources management plan to be developed and implemented by the contractor with support of MWE.
4	Cultural site	Concern was raised on likely impact on graves and on whom the responsibility lies in case these are affected during construction works.	Cultural sites will not be destroyed. The project will try as much as possible to avoid the cultural sites and, in the event, that they can't be avoided, the owners and local leaders will be consulted on the procedure for relocation.	A chance finds procedure has been included in the report to be followed in case of any chance findings.
5	Social ills such as family breakage, defilement, rape, theft among others	Community raised concerns regarding influx of workers from other parts of the country which may cause tension in the communities since they usually do not move with their families. This may push them into engaging in sexual relations with married people hence breaking their marriages or escalating domestic violence, sexual abuse of school children hence increasing the number of school dropouts and early and unwanted pregnancies.	The contractor will develop and implement a strict code of conduct for workers against such interactions in addition to continuous sensitization of both the community and workers.	Contractor shall develop and implement a workers' code of conduct.

Photographs of consultation meetings are presented below


Photo 6-7 Community consultation meeting in Nyanga


Photo 6-8 Community consultation meeting in Nkunda


Photo 6-9Community consultation meeting in Kibimbiri


6.3.3 Batwa Consultation

During the stakeholder consultations, a key aspect that came through was the existence of vulnerable and marginalized group of people; Batwa, approximately 3.84 km south of Matanda Irrigation Scheme command area specifically in Kengoma and Kanyashande cells, Kihembe Parish Kanyantorogo subcounty. Representatives were consulted during scoping. Consultation with Mr. Kamara Christopher a munyabutumbi residing in Kanyashande cell with the Batwa on 28th May 2019. He holds a Diploma in Agriculture, current secretary for Works and Technical Services Kanungu District, and political councillor for Kanyantorogo subcounty.

During the detailed study stakeholder engagement, the Batwa community, living in the Model village set up by Bwindi Mgahinga Conservation Trust, was consulted on 23rd November 2019 (Figure 6-9) and a summary of their concerns, suggestions, and views is presented in Table 6-6. However, in the updated studies of the command area extent, there were no Batwas, or any other indigenous groups of people encountered.

Table 6-6:Batwa study summarized minutes.

No	Issue	Concern
1	Inadequate land for cultivation	The main concern raised by the Batwa was lack of land for cultivation. Most of them are renting small parcels on which they grow some crops on a subsistence level.
2	Main economic activity	They practice agriculture and food production, including Beans, Groundnuts, Maize, Cassava and other crops on rented land. However, many of them offer manual labour in other people's farms for a wage payment.
3	Training requirements	The women are talented in handcraft and so requested for training to acquire skills in weaving such baskets, mats among others so as to make better products that can be sold to a wider market to supplement their income.
4	Land requirement	They requested that they be given enough land for farming and livestock and shall be considered as beneficiaries of the different government programs such as the irrigation project, Operation Wealth Creation and NAADS among others.
5	Perceived impact from "foreign" foods	Originally, they were accustomed to hunting and eating wild meat, wild fruit, honey, tubers, wild berries, and fish. They were disconnected from the above food and long for it. They have a belief that the current common foods e.g cassava, beans etc. are reasons why they are dying.

Photo 6-10 Consultation of the Batwa community during detailed ESIA study.

Following the discussions that culminated in adjustment of the dam embankment location and as part of continuous stakeholder engagement throughout the ESIA and RAP studies, the consultant undertook curtasy visits/consultation to all the stakeholders in March 2020 that had been consulted before to explain these changes but also seek views that might have significancy in the project implementation. Guided by Covid 19 pandemic standing operations, these reorientation engagements were undertaken at individual office level without gathering people together. In any case, the same categories of stakeholders had been consulted on the same project during ESIA update.

Major concerns that come out through these continuous debriefs included requested to compensate people in events of land take and displacement, continuous sensitization of the mases regarding any change in project design, need to have the plans shared with the stakeholders.

6.3.4 Uganda Wildlife Authority (UWA) Consultation

UWA was consulted to collect their views, concerns basis to approximate of Queen Elizabeth National Park to project Zone of Influence.

Table 6-7: UWA officials consulted for proposed Matanda Irrigation Scheme

Stakeholder	Participants		Date	Reference figure
	Name	Position / Title		
UWA	Justine NAMARA	Manager Environment	20.02.2023	Figure 6-10
	Oscar Wallace TUMUKUNDE	EIA and planning		

Table 6-8: Emerging issues from UWA

No	Issue	Stakeholder views	Response by the consultant
1	Biodiversity Team	The consultant's team shall be composed of a full-fledged biodiversity team	The team has a number of biodiversity specialists headed by Richard SSEMMANDA.
2	Pathogenic activities	All pathogenic activities along River Kiruruma in the project area shall be captured and documented.	All pathogenic activities along the river profile (upper stream, mid-stream, down-stream) were captured in social-economic survey.
3	Wildlife-human interaction	Electric fence along the park and project area is a good suggestion, however reference to the death of lion case, UWA demands that a separate ESIA must be conducted for any intended electric fence project. **Note:** ▪ There is an existing trench at the Kigezi Wildlife side currently deterring elephants crop raiding. The trench has been in existence for decades and is maintained by the community with support from UCF and WCS. ▪ UWA has a plan (still at proposal stage) to fence off Ishaha side (the same area near the project) with an electric fence. However, as of January 2025, the construction of an electric fence along the park and project area by the Uganda Wildlife Authority (UWA) under the World Bank-funded Investing in Forests and Protected Areas for Climate Smart Development-(IFPA-CD) Project P170466 was over 80% complete	Noted

Photo 6-11: Consultation of UWA during detailed ESIA study update

POTENTIAL SOCIAL-ENVIRONMENTAL IMPACTS

7 POTENTIAL SOCIAL-ENVIRONMENTAL IMPACTS

This section of the report presents Identification, analysis and evaluation of type and extent of likely potential environmental and social impacts with emphasis on significance, magnitude and distribution of beneficial/ adverse effects of the planned scheme on the existing biophysical and socio-economic environmental components, during the construction, operational and decommissioning phases of the project. It also presents the enhancement measures for the positive impacts while mitigation measures are presented to avoid, minimize/reduce, or offset the identified adverse impacts.

7.1 POSITIVE IMPACTS

7.1.1 Income to material / equipment suppliers and contractors

The project will require supply of various materials and/ or equipment in all phases. For example, pre-construction will require deployment of construction equipment, construction cement, aggregates, sand, etc. and post construction maintenance tools, some of which can be sourced locally. Some equipment and materials, for example, pipes, sprinklers, steel materials required for the project will be sourced nationally and internationally to ensure that the desired quality is achieved. Local suppliers of materials and equipment who get involved in the project will benefit financially.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Enhancement

Earth materials needed for construction, for example, murram, aggregate (stones and sand) shall be largely obtained from the project affected villages as to attribute to achievement of project local content. However conscious or unwitting purchase of these materials from unlicensed operations would indirectly support, encourage or promote environmental degradation and possibly causing medium- to long-term negative impacts. It will therefore be a contractual obligation for contractors to procure construction materials from sources that are legitimate or licensed by the Authority (NEMA).

7.1.2 Rental income for workers camp and equipment yard site owners

The project will necessitate setting up temporary contractors' camp and equipment yard and acquisition of Stone Quarries, borrow pits/areas, Clay extraction, including constructing of access roads to those sites. Owners of land on which these facilities will be erected will earn a rental income negotiated with contractors. This is a positive but short-term and reversible benefit ceasing with project completion or whenever such facilities are no longer required in a given location.

Project phase impacted	Pre- Construction	Construction	Operation (Post Construction)
	√	√	

Impact enhancement

i. As a contractual obligation, contractors shall clean up and restore sites where temporary facilities had been erected, when their use ceases. All waste thereon shall be removed and responsibly disposed of. Any contaminated areas on site shall be remediated as part of site restoration.
ii. The contractor shall enter into agreements with the landowner and shall ensure adherence to the conditions therein.
iii. The contractor shall hire a NEMA registered sub consultant to undertake ESIA for the identified sites. The contractor shall ensure compliance to the conditions of approval of these ESIA certificates.
iv. The contractor shall adequately restore the site used in order to ensure that these sites continue to be productive to their owners. The agreements entered by the contractor and landowners shall include clauses on restoration.
v. The contractor shall obtain workplace registration certificate from department of Occupational Health and Safety, Ministry of Gender, Labour and Social Development.
vi. The contractor shall ensure fair, adequate and timely payment to the landowners.
vii. The contractor shall design site lay out and architectural drawings for the campsite and equipment yards for approval by the respective Sub-counties/Town council and Kanungu District. The contractor shall also apply and obtain development permit from the Sub-counties/town council and district.
viii. The contractor shall ensure that all structures within the site are maintained in a state of cleanliness.
ix. The contractor shall prepare a decommissioning plan for approval by MWE, Kanungu district. He/she shall further ensure that after construction activities, the site is cleaned and restored to near its original state such that the landowners can use it productively.

7.1.3 Employment

According to UBOS Abstract for Isingiro District, is reported that about 6,039 (6.3%) youth are unemployed. Therefore, the planned irrigation scheme will likely provide opportunities to work in construction and related engagements thereby contributing to youth empowerment. The project will avail both skilled and unskilled job opportunities for residents in the project area, Ugandan nationals and internationals, especially the youths. Skilled labour will include artisans such as engineers, plumbers, carpenters, masons while unskilled labour will include trenches for the closed pipeline network distribution excavators (casual labour). The villages in the project area have youths aged between 18 and 35 years who are not in school and not working but are young and energetic. Therefore, this age group shall be considered for employment especially during construction. Indirect job opportunities during construction will arise from provision of services to the contractor and his employees. During the operation phase, long-term technical and non-technical job opportunities for professionals (engineers that will maintain the system), casual labourers (farmers) will be available to operate and maintain the scheme. Agricultural water supply will boost the livelihoods in the project area, and this will indirectly attract more job opportunities.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Enhancement:

The contractor is required to draft and submit a Labour Management Plan for approval by the client. A Contractors Labour Management Plan shall be drafted in line with the Labor Act, Employment Act, and OHS Act. The plan will address issues of workers' welfare, child labour, workers code of conduct, sexual harassment among workers, compensation in cases of accidents, payments and contracts, and a grievance management.

- All contractors' staff shall bear appointment/ offer letters, contracts and identification tags. This will apply to also subcontractors on the project.
- The contractor shall use locally available labour for the unskilled labour requirements and where the required skills are available locally, the local people will be given first priority commensurate to their level of training. This will have the advantage of enabling the local community take responsibility in owning up the project.
- Persons seeking employment will have to be screened, including references from the local Council Chairpersons of their villages of origin before engagement. These shall also present their original National IDs, of which a copy will be kept on file. Also, background checks on all people before employment shall be conducted.
- To the extent possible, equal employment opportunity shall be available for women. Fair treatment and non-discrimination among staff shall be affected by the contractor.
- Monitoring by the LC1 during recruitment will be necessary for transparency.
- A training programme for artisans (builders, carpenters, plumbers) in the project area could be facilitated by the project to ensure skills transfer during the construction period.
- The construction contractor shall be encouraged to pay a 'living wage' to all workers involved in project implementation.
- The construction contractor will be obligated to work within Uganda's labour laws (*Employment Act*), including restrictions on child labour especially where it can interfere with the child's education.
- Adequate occupational health and safety standards shall be provided to ensure the work environment is conducive.
- The construction contractor shall be selective in awarding service contracts, giving preference to women-owned entities. This, for example, is in regard to preparation and supply of foodstuffs to workers on site.

7.1.4 Benefit to local retail businesses

This project will have construction works on-going for a period of 5 years. On-site facilities tend to be minimal during the Planning Phase such as clearing and siting for material lay down grounds, so reliance on the local community for products and services tends to be quite high, even if by limited numbers of personnel and for short periods. A positive impact would be increased business for shops and services, particularly those in linear market developments along main roads accessing the proposed Project area. The local communities will gain through the sale of items like food stuffs, drinks and other consumable products especially women (and their households) who would be involved in such businesses. They will also benefit indirectly from the

increased spending of the workforce. The increase in demand of products will lead to increased supply and creation of market for products thereby improving the incomes and general welfare of the local communities and their families. This would also apply to guest houses or other places offering local accommodation. The impact will be short term for those with existing small businesses which are easily accessible. However, relatively few businesses will benefit, influxes of personnel will be limited to relatively small numbers, and influxes will be sporadic, depending on the field activities. Also in the long run, during operation, there will be increased business for environmentally friendly pesticides, fertilizers, seedlings, available locally. This will increase the retail revenue that attributes to SDG 8 (Promote sustained, inclusive and sustainable economic growth). The likelihood of this impact occurring is certain, and the significance is considered low positive.

Project phase impacted	Pre- Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Enhancement

- During the project progress meetings with local community, the local residents shall be informed about the project and how their businesses can benefit from the project.
- Sensitization of the construction contractor and his staff about public health aspects mainly based on consumption of such food stuffs bought at the construction site from the locals.
- Use of quality products with standards meeting Uganda National Bureau of Standards.

The presented anticipated impacts below are attributed only for Operation phase (Post Construction)

Project phase impacted	Pre- Construction	Construction	Operation (Post Construction)
			√

7.1.5 Infrastructure Improvement

Implementation of such a scheme, will trigger infrastructural development in the project area, e.g., through agricultural credits, stores, access roads, restaurants, but a few. This will in turn stimulate investment and employment and helps improve marginal investment opportunities, which will ultimately lead to opening up to; local, national, regional, global markets and hastening of transportation of farm produce.

Impact Enhancement

- The extent to which development becomes a positive or negative impact will be determined by the effectiveness of the town planning framework. Such induced developments shall be of a type that is desirable and sustainable and for this to happen, all future developments must be undertaken within the framework of proactive government policy and strict planning and environmental enforcement by the responsible Local Government.
- Integration of sustainable development programs, such as youth empowerment, local road infrastructure linkage, but a few alongside the agricultural command area.

7.1.6 Transformation of agricultures practice in the areas

The proposed Matanda Irrigation Scheme is consistent with GoU strategic development enshrined in its Vision 2040 in which, the country strives to transform its economy from largely peasantry and subsistence agriculture to modern economy. In this Vision, Uganda aspires to transform the agriculture sector from subsistence to commercial agriculture through mechanization and introduction of modern irrigation systems which is what is being planned under this project. With the growing effects of climate change on weather patterns, more irrigation will be needed. Average yields in irrigated farms are 90% higher than those of nearby rain-fed farms. Implementation of the project will lead to increase in agricultural activities resulting from increased expansion of land under agriculture. This will in turn increase agricultural yields and production, generating additional revenues directly from the project output, thus improving the farmers' livelihood. MWE has hired a stakeholder engagement consultant to undertake project awareness creation including impacts and available mitigation. MWE will further provide additional support for agricultural extention to enable farmers adopt transformative agricultural practices.

Impact Enhancement

- The farmers in the command area shall be sensitized about the advantages chemical fertilizer through exhibitions and these inputs shall be made easily available through co-operative societies/ farmers associations. Liberal supplies of insecticides and pesticides shall be distributed at the cheap rates all over the Kanungu District.
- To save the farmers from the clutches of moneylenders, adequate credit facilities shall be made available at reasonable cheap rates in the project area. Credit societies and farmers associations shall be strengthened to provide loans to the cultivators. Moreover, integrated scheme of rural credit shall be implemented.
- Adoption of farm management software, this will help farmers in the command area to take complete control over farming activities and analyze usage of all inputs and expenses, so as to identify weak points and make proper improvements.
- Increased coordination and planning by Kanungu District agricultural officers and Engineers, MAAIF, MWE, but a few concerning agricultural activities in the scheme.

7.1.7 Crop diversification

Currently, the main crops grown in the area are maize (49.8%), followed by beans (22.2%) and millet (13.5%). With the introduction of irrigation, farmers will be enabled to diversify their crops based on local markets demand and export. This will reduce farmers' dependence on only one crop which can lead to huge economic losses in events such as climatic changes and attacks by pests and vermin. Once the irrigation scheme is operational, it is expected that, the farmers will take up horticultural production thereby diversifying their income base. This diversification implies diverse sources of income at household and improved livelihoods as well.

Impact Enhancement

- Sensitization of farmers regarding the adoption of pest resilient crops and technology arrangements shall be made for agricultural education and extension services. It would assist the farmers to take proper crop-care leading to increase in crop productivity.
- Practice of seasonal soil rotation; it is important to understand how planting recurring crops can affect overall yield. Planting an alternating crop helps to diversify the demands on the soil. This results in crops that not only yield more, but continually produce year in and year out.
- Use of high quality and low-cost seed could be the basis for increasing crop yields. Using hybrid seeds that are naturally inclined to grow faster, stronger, and with greater efficiency is pivotal to the success of scheme.
- By carrying out sound research and development initiatives on resilient crop types.
- Cropping technical assistance, through training on 'non-conventional' farming methods and on innovative ways to share faming knowledge to the command area cultivators.
- The selection of a low volatile or high productive cropping system.

7.1.8 Sustainable and optimal use of irrigation water resources

The project provides opportunity to promote agricultural development strategies through sustainable use of the country's freshwater resources through measures such as irrigation coupled with catchment management interventions. Available information indicates that, with even full exploitation of irrigation potential only 14.1% of Internal Renewable Water Resources will be utilized. To mitigate rampant country wide seasonal local scale water shortages, GoU plans to put in place large and medium water reservoirs as planned under this project. Due to implementation of the project, there will be expansion of land under irrigated agriculture (4420 Ha irrigated command area) as well as improved land management programmes are likely to result with increased agricultural outputs. Whereas the dam is to serve total of 9000 Ha, the pipeline network distribution only covers 4420 Ha under the current design.

Impact Enhancement

- Ensuring proper water drainage; water management is essential to crop survival and maximizing yield potential. It's important to ensure that the irrigated crops are getting enough water, but also that they aren't being over-watered.
- Community sensitization in regards to irrigation technology utilization.
- Integration of other government programs related to irrigated agriculture to support the scheme.

7.1.9 Improved Food Security and Nutritional Status

Serve to address food security in the areas of the project: The planned irrigation project, is a timely intervention by GoU to address water scarcity which has chronically affected crop production in Kanungu

District. Therefore, the planned irrigation intervention is timely in addressing water needs for crop production and addressing food security a situation which is worsening by over-reliance on traditional rain-fed crop production. There is set to be an increase in the quantity of food produced once the project is operationalized. Food security will be achieved both at individual household level, district level and at the national level due to the increase in food production from the command area. Increased farming of different crop varieties will ultimately lead to improved nutrition as well as improved health in the long run. There is meant to be a boost in the amount of food available for consumption to the residents thereby reducing dependence levels. In this case, the irrigation will have a paramount importance in further improving the overall living conditions of the people residing in and around the Kanungu District.

Impact Enhancement

- Provision of intermediate technological solutions such as light machinery and affordable tools will encourage farmers in the command area to test them. New tools and practices can be better tested to the local conditions through participatory research.
- Adoption of policies supporting private and public agricultural input and output, market development, and inducing adoption of more diverse, resilient, and profitable cropping systems.
- Adoption of crop diversification as a strategy for addressing food and nutritional security.

7.1.10 Improved Land use and increased household acreages

In most rural areas, crop production systems using rudimentary cottage labor and equipment have for long typified agricultural production in the proposed project areas which in a way has kept it plunged in food insecurity, limited production and productivity, limited household acreages summing to poor household incomes. In addition, the irrigation technology to be introduced will likely be one which is more adaptable can be customized to household levels. The project is envisaged to assist farmers clear their lands alongside a host of farming husbandry support services which will bring about improved production at household levels. There will be improved land conditions due to improved land management, such as, land and water conservation activities (soil conservation programmes) resulting in improved soil fertility. This will in turn improve agriculture yields thus more revenue for the farmers.

Impact Enhancement

- Sustainable utilization of fertilizers; cultivating farmland soil with fertilizers is an important part of maintaining optimal soil conditions for crops. Fertilizing the crops at the time of seeding will help provide the seeds with essential nutrients like potassium, phosphorous, and calcium.
- Scouting the farmland; this will give the farmers in the command area a chance to assess soil conditions, notice any weeds cropping up, and check if crops are growing healthily.
- Regular testing of farmland soil quality; examining the phosphorus, potassium, and fertilization levels will give farmers in the command area an insight into how to handle the crops. It will also alert them, when proper soil conditions are forming, such as the optimal density and right amount of nutrients.

- Weeding early and often; weeds are invasive, and siphon nutrients away from the crops that need to be continuously removed to reduce nutrient competition.
- Applying conservation tillage practices as to save time, fuel and machinery wear.
- Sensitization of farmers in the command area about the right type of fertilizers available, prices and applications.

7.1.11 Market Infrastructure

Currently, agricultural produce mainly is sold locally and regional markets. Implementation of the project will trigger increase in agricultural and more produce necessitating the construction of improved market infrastructure and market access facilities, causing improved trade locally, nationally and internationally.

Impact Enhancement

- Marketing infrastructure shall be widened and strengthened to help the farmers to sell their products at better prices. There shall be proper arrangements for unloading of the produce in the markets.
- Price support policy shall be adopted and minimum prices shall be guaranteed to the peasants in the command area.
- The farmers in the command area shall be supplied with quality inputs at proper times and at controlled prices.
- Farmers in the command area shall be encouraged to know the yield potential of the farmland, especially understanding the; field's growth potential, kind of crops to plant, and kinds of seeds to use, when assessing yield potential.
- Marketing training of farmer in the command area, with content including; new skills, new techniques and new ways of obtaining information in agriculture.

7.1.12 Enhanced values of the agricultural produce

Farmers in the command area will be empowered to carry out basic value chain addition. This will result in improved value of agricultural produce through the value addition processes. This will increase the marketability of the produce both locally and internationally thus increasing the revenue and subsequently the livelihoods of the farmers.

Impact Enhancement

- To check the sub-division and fragmentation of holding, the movement of co-operative farming shall be launched. Co-operative farming would result in the adoption of modern technology on so-called big farms. In this way, agriculture in the command area will become profitable occupation through economies of large-scale farming.

- Planting early and effectively through choosing the right time to plant will be the best strategy to use. Planting early will result in increased yields by taking advantage of unexpectedly early favorable soil conditions.
- More emphasis shall be made to set up cottage and small scale agro-produce industries. This will raise the income of the peasants and keep them busy during the off season.

7.1.13 Local tourism potential

Irrigation projects can facilitate the development of recreation facilities through exchange field visits of farmers from different areas to acquire knowledge and skills, and this in turn creates avenues for tourism. Therefore, the proposed development of a water reservoir and an irrigation scheme may act as a tourist attraction, thereby generating income for the local people, the government and the proprietors of recreational centers and tourism facilities. In addition, the irrigation scheme will attract the students from different schools for study tours. The impact will be long-term and it will be at national/international scales. It will moderately benefit the communities and those outside the project area, and the likelihood of the impact occurring is probable. The significance of this impact is therefore expected to be moderate to high positive.

Impact Enhancement

- Construction of the scheme as per standards and specifications in the approved design.
- Implementing a scheme maintaince plan.

7.1.14 Dam filling

The Matanda scheme dam located on river Kiruruma in Kishunju and Muruhura village (considering both sides of the river), during filing phase will bear positive environmental effects including:

- Creation of new or expanded habitats for aquatic wildlife, and attraction of terrestrial life forms. The filling of the reservoir will lead to expanded living spaces and enable processes of biological colonization, creating new habitats for different aquatic life forms while also leading to emergence of new terrestrial water dependent life forms.
- Changes in hydraulics and hydrological parameters of the river allowing for increased clarity of water and primary productivity to support new life forms in the reservoir.

Impact Enhancement

- Monitor the colonization and changes in assemblage of aquatic and terrestrial life forms as the dam fills so as to possibly weed out an unwanted invasive life forms such as water hyacinth. This shall include regular evaluation of the changing ecological effects.
- Support recolonization of naturally recurring deep water species or life forms.
- Implementation of the monitoring plan to study the changes in hydraulic and hydrological parameters of the stream, and how the changes are impacting on productivity of the waters.
- Implementation of the reservoir management plan and adherence to and regular e-flow (Table 5-70).
- Supporting fishing communities with fish cages to enhance their livelihoods.

7.2 RISKS AND NEGATIVE IMPACTS

7.2.1 Risks and potential negative impacts on public safety

Public safety in this context is the condition of the project community being safe from undergoing or causing hurt, injury, or loss by the project activities.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: Curious students and locals (Impact Receptors) may hang around the sites/ command area and dug trenches for the closed pipeline network distribution causing a safety risk. Other community safety hazards include noise, dust, project traffic, material and equipment loading and offloading, but a few. This impact is short-term during both in the pre-construction and construction phase and long-term in the operational phase.

Impact Significance: Given that the project will involve construction of major hydrological infrastructure at the source (Water diversion weirs), 600 mm deep trenches for the closed pipeline network distribution stretching in the entire command area extent (9000 Ha) which covers (5) sub counties (district extent), the likelihood of occurrence of this impact is high, in turn rating a ***High*** impact intensity. In case of occurrence of this hazard (exposure to the receptor), there may be near misses or reportable lost time injury or dangerous occurrence or fatal community cases which may have legal implication causing a delay in both implementation and operation of the scheme hence causing a temporal lag in the project time lines, rating ***Medium*** Impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Major*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures
During Construction

- Enforce restrictions on unnecessary entry into the construction working area.
- Hording off the source construction site.

- Conduct safety awareness campaigns in schools and project communities about the risks of students/ locals coming close to the construction site.
- Continuous community awareness about safety risks related to the constructed irrigation network distribution in the command area.
- Safe vehicle speed limits shall be instituted and enforced at site including vehicle maneuvers around the site.
- OHS signage that is clear and visibly displayed shall be used to warn off the community, curious passers-by and project employees of dangerous areas such as deep trenches or slippery areas along the channels.
- Follow mitigation measures prescribed to reduce any dust or noise impacts.

Impact Mitigation Enhancement during Construction

✓ Managing site access by defining site boundaries clearly and physically to prevent the community from entering the site and prevent particular objects from escaping.

✓ Deployment of a contractor's Traffic Management Plan (TMP) to reduce project traffic related community accidents.

✓ Deployment of a contractor's Environment, Social, Health and Safety Plan (ESHSP) and Emergency Response and Incident Management Plan (ERIMP) to alleviate public safety risks.

✓ Deployment of project Grievance Management Plan (GMP) as to capture and handle public safety reported risks.

✓ Empowering of scheme beneficiaries (farmers in the command area) in management of personal and public safety.

✓ The contractor will bear the full accountability of creation of a safe environment for both the project workers and the community at large.

Residual Impact

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	High	Medium	Major 12
Residual Impact	Medium	Very low	Minor 3

7.2.2 Impact on local area water hydrology

Hydrology in this context is the movement, distribution, and management of water in the project area, its physical and chemical properties and its relationship with the living and material components of the environment. It also codes of Water Source Pollution as contamination of River Kiruruma and command area surface and underground water sources water quality by the project activities. Matanda irrigation scheme drains an area of approximately 137.9 km^2.

	Construction	Operation (Post Construction)
Project phase impacted	√	√

Impact Evaluation: The water sources in the project area, socio economic activities of the downstream users and biodiversity (Impact Receptors) may be affected during both scheme construction and operational phases. The district has many small rivers and streams like Ishasha, Nchwera, Kiruruma, Birara, Mitano and Lake Edward, which is the main source of fish besides fishponds. The district is also endowed with a number of wetlands, both seasonal and permanent, which serve as water reservoirs and other ecological factions. 31.4% of assessed water sources in the project area by the community are the rivers/streams in the entire project area. It is noted that the dam will impact the flow in a number of streams in the area:

(i) the dam will inundate the main river and tributaries upstream (largely absent from the impact assessment);
(ii) the abstraction will decrease the flow in the Kiruruma river and the flow in rivers subsequently joining downstream; and
(iii) the water abstracted will be used for irrigation, and some water will 'reflow' to the Kiruruma but also to the Matanda and Kasinga rivers which will receive increased flow as compared to natural flow (inter-basin transfer).

During construction and Dam filling

Change of flow regime

River diversion means that some change to the local hydrological regime will occur. Changes to the flow regime may have significant negative impacts on downstream users (socio economic activities), whether they abstract water. The quality of low flows is also important.

Increasing runoffs

The laying of water pipeline, construction of the dam and water abstraction structures and associated facilities, for example, contractor's camp, will result in direct disturbance of soil. Site preparation will involve clearing of strips of vegetation to allow for excavations to begin. The steep sloping terrain makes soil erosion and sedimentation likely impacts. Soils excavated may be heaped besides the trenches hence exposed to agents of erosion such as wind and storm water. Depending on the nature of the soil, this may lead to a temporary increase in erosion. The degraded soils can end up into the stream thus increasing river turbidity. The high turbidity can make it difficult to see and catch prey; may bury and kill eggs laid on the bottom of the river; harm fish by reducing food supplies, degrading spawning beds and affecting gill function; significantly reduce the aesthetic quality; and increase cost of water treatment for drinking. These are short term and direct impacts. The sensitivity of the receptor is high because of the Kiruruma stream close to the site. The intensity of the impact is assessed as Medium.

Change of physical chemical conditions of the river

Alteration of the natural temperature, electrical conductivity, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Nitrates, Phosphate levels, attributed to accumulated organic matter with sudden and intense changes in the key attributes of aquatic habitats, followed by predominantly heterotrophic processes, with possible thermal stratification and anoxic conditions, both within the reservoir and downstream of the dam. Changes in species dominance leading to displacement and or loss of some species, may increase vulnerability of the downstream area mainly during dam filling phase.

Improper solid waste management

Solid waste and spoil will be generated at the site during site preparation and construction phases. The waste may consist of timber or metal cuttings, excavated materials, paper/cement bags and solvent containers among others. Some of the waste materials such as cement, adhesives and cleaning solvents contain hazardous substances, while some of the waste materials including metal cuttings and plastic containers are not biodegradable and can end up into the river and can have long-term and cumulative effects on the environment. The impact can be regional in case the waste ends up in rivers and the impact intensity is assigned High for short time.

Contamination of water resources

There is potential of contamination associated with the construction activities around weir construction at River Kiruruma, which include: sediments, oils and greases contain hydrocarbons and/or heavy metals such as lead, chromium and cadmium, which are known domestic water pollutants. Contaminants introduced by construction could migrate into river Kiruruma. Given the size of Kiruruma stream, intensive sedimentation would have far reached effects in addition to its flooding nature during the rainy season but the activities taking place in its catchment already largely contribute to the sediment transport. Increased water runoff and seepage from the work sites could potentially result in contamination of surface water and underground source aquifers.

Eutrophication and floating aquatic vegetation

Eutrophication is expected to occur in the reservoir due to the sedentary waters, nutrient loading from flooding of nearby grounds, causing increased algal production and increased emergence of aquatic vegetation including floating weeds, which results in temporary loss/destruction of fishery habitats; loss of feeding and breeding cues for aquatic organisms including fishes; emergence of nuisance species and disease vectors such as mosquitos; and rapidly diminishing water flow currents that may lead to disorientation of fishes and other aquatic organisms.

During the operation

Water pollution

It is anticipated that the command area will bear non-point sources of pollutants mainly due to application of pesticides, fertilizers, and soil erosion in the command area. Water pollution from fertilizers or application of pesticides occurs when these are applied more heavily than crops can absorb. These crop farm pollutants may inter to the water sources through direct surface run off or through seepage to ground water. Moreover, sediments produced by farming induced erosion can often transport excess agricultural chemicals resulting in contaminated run off, which in turn affects aquatic habitat. The main source of excess nutrients in surface water from non-point sources of this project is expected to be chemical fertilizers. Excess nitrogen and phosphates can leach into groundwater or run off into waterways. This nutrient overload can attribute to eutrophication of receptors leading to an explosion of algae which suppress other aquatic plants and animals.

Change of water flow regime

The consumptive nature of irrigation means that some change to the local hydrological regime will occur when new schemes are constructed. Changes to the low flow regime may have significant negative impacts on downstream users, whether they abstract water. Minimum demands from both existing and potential future users need to be clearly identified and assessed in relation to current and future low flows.

The quality of low flows is also important. Return flows are likely to have altered water quality, especially if substantial quantities of pesticides and herbicides are used in the scheme. Low flows need to be high enough to ensure sufficient dilution of such likely pollutants discharged from irrigation schemes.

A reduction in the natural river flow together with a discharge of lower quality drainage water can have severe negative impacts on downstream users, including irrigation schemes. Habitats both within and alongside R. Kiruruma and the other surrounding rivers are particularly rich in the context of the command area and support a high diversity of species. Large changes to low flows (± 20%) will alter micro-habitats of which riparian areas are a special case. If this ever happens, the impacts can affect a large area downstream of the abstraction point and the impact intensity could be High.

Changes of flood flow regime

Radically altered flood regimes may also have negative impacts. Flood waters are important for aquatics in rivers. Controlled floods may result in a reduction of groundwater recharge via flood plains and a loss of seasonal or permanent wetlands. Changes to the river morphology may result because of changes to the sediment carrying capacity of the flood waters. This may be either a positive or negative impact. As with low flows, the operation of dams offers excellent opportunities to mitigate the potential negative impacts of changes to flood flows. The designation of flood plains may also be a useful measure that allows groundwater recharge and reduces peak discharges downstream.

Flood flow regimes are essential for sediment transfer into flood plains, recharge of groundwater, and sustainability of permanent and seasonal floods. As an EFR, the weir structure across the river shall allow passing of the small and large flood magnitudes as indicated by the Environmental Flow Components (EFC). This study recommends the weir structure for the proposed irrigation scheme abstractions to be designed in such a way that small floods with minimum peak flows of 11.2 m^3/s and large floods of minimum peak flow of 15.3 m^3/s are conveyed downstream for environmental functionalities, especially in flood plains.

Use of irrigation water for domestic use (bathing, washing)

Through consultation with the community (Appendix C), only 5.5% of the community members requested to use irrigatable water for domestic use. Also reference to the household survey, majority of the households (48%) indicated that they travelled less than 50 meters to get water, followed by 26.4% who moved a distance between 100 - 500 meters, and those who move over 1 km were 5.5%. This implies that majority of the respondents in the area had access to clean water within their yards or immediate neighborhood. The irrigation distribution networks will act as alternative sources, yet they have untreated water. The continuous

use of unsafe water is likely to affect human health by increasing human health risks such as incidence of water related diseases.

Impact on ground water

The project will not extract groundwater for purposes of irrigation, therefore there will not be any impact on the availability of groundwater from the project or water levels. In addition, technology proposed in the project does not allow extra water to infiltrate below the root zone since the rate of application always ensures that the soil moisture holding capacity is not exceeded. However, possibility of groundwater contamination has been investigated in consideration of groundwater recharge from rainfall (section 5.7.9).

However, there are likely impacts of increased groundwater level in irrigated area and evaporation changes to natural moisture levels in the surrounding atmosphere, which can cause instability in the atmosphere and/or increase levels of downwind rainfall.

1. **Waterlogging:** Excessive groundwater levels may lead to waterlogged soils, harming crops by reducing oxygen availability to roots, causing root rot, and stunting plant growth.
2. **Salinization:** In areas with high evaporation rates, rising groundwater may bring salts to the surface, leading to soil salinity issues, which can decrease agricultural productivity.
3. **Infrastructure Damage:** High groundwater may affect buildings, roads, and irrigation infrastructure, causing structural damage and increasing maintenance costs.
4. **Decreased Soil Fertility:** Waterlogged conditions may lead to nutrient leaching, which depletes essential nutrients from the soil, negatively impacting crop health and soil fertility.
5. **Increased Disease Pressure:** High soil moisture levels may create a conducive environment for plant diseases, such as fungal infections, which thrive in wet conditions.

However, the Matanda irrigation scheme will be supplementary irrigation with seasons high rainfall which naturally helps in leaching the salts in the soils and therefore the impact is not significant.

Mitigation

Balancing groundwater levels through proper management practices such as irrigation water use efficiency to avoid these negative impacts while benefiting from the positive aspects.

Impact significance: Given that the project will involve construction of major hydrological infrastructure at the source (Water diversion weirs) and 600 mm deep trenches for the closed pipeline network distribution stretching in the entire command area extent (9000 Ha), which covers (5) sub counties (district extent), there is a high likelihood of;

- Water pollution during the site clearing process (construction phase),
- Changes to the River Kiruruma morphology may result because of changes to the sediment carrying capacity of the flood waters,

- Toxic chemicals getting soaking through the ground and leach into the groundwater (mainly operational phase), and
- Impact on socio economic activities (*see section 5.3*) of the downstream users especially during dry season (*see section 5.1.10*).

However, this study found the e-flow value of 0.58 m^3/s is sufficient given the current field observations. Further considerations were, however, made of all possible uncertainties related to the river dependence that could result in future, partly as a result of the proposed irrigation scheme development in the area and built in a factor of 0.10 to cover such uneasily foreseeable extremes. With that uncertainty consideration taken care of, therefore, the final revised e-flow requirement for R. Kiruruma would be 0.64 m^3/s and a one in two-year flood of 13m^3/s. In determining the environmental flow for this project, a key guiding principle was to ensure that there is no risk of critical lack of water in the river even during low flows to ensure the sustenance of river health and aquatic life therein. This is because even if higher flows ensued after a period of flows that are below environmental flows, irreparable damage would already have occurred (due to lack of water or drying up of aquatic habitats/ nooks among riverbed boulders in which fish may hide or spawn). This situation needs to be avoided by both design and operation of the proposed irrigation project. The design of the weir and Dam structure shall consider the high-water levels corresponding to the small and large floods to ensure safe passing to downstream reaches of the river. To ensure that the e-flow is maintained, participatory community monitoring mechanisms will be put in place to specifically include the establishment of community monitoring team composed of representatives of farmers, local government and water user associations.The project will further build capacity of the local monitoring committee to be able to carry out their duties.

The soil types identified in the command area were Happlic Ferralsols, Acrisols, Arenosols, Skeletic Leptosols, Gleysols, Gleyic Fluvisols, and Vertisols. With the exception of leptosols, the rest of the soils covering more than 95% of the command area are suitable for Irrigation.

Return flows are also likely to have significant quantities of pollutants, in turn rating a ***Medium*** impact intensity. Low flows need to be high enough to ensure sufficient dilution of pollutants discharged from irrigation schemes. A reduction in the natural river flow together with a discharge of lower quality drainage water can have severe negative impacts on downstream users (especially their socio-economic activities), including irrigation schemes. Habitats both within and alongside rivers are particularly rich, often supporting a high diversity of species. Large changes to low flows (± 20%) will alter micro-habitats of which wetlands are a special case. Many groundwater sites in the project area are also used for human consumption and contaminated groundwater is a lot harder to treat than surface water. Receptors exposure will be on a regional extent, since River Kiruruma connects to other waterways, rating ***High*** impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Major*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- All construction equipment shall be kept in good operating condition to avoid oil or fuel leakages that might contaminate water resources. Poorly maintained machinery shall not be allowed to operate on site. All routine maintenance of construction machinery and vehicles shall be carried out in a designated workshop / maintenance area with concrete hard standing surface and drainage to an oil interceptor.
- Create a diversion channel (a coffer dam/dyke so that the river-flows through) around the construction site to allow for continued flow downstream during construction and filling of the reservoir.
- For fuel dispensers at camps, workshops and equipment areas, the fuel tanks shall be kept in bunded walls to contain any spills and dispensing areas paved with drainage fitted with oil interceptors. Oil spill kits shall be kept at active construction sites and workshops to handle any accidental spills during construction.
- Water quality of the source (at construction site) shall be monitored monthly, with samples taken and analysed for all forms of contaminants.
- Any hazardous wastes including material soiled with hazardous wastes and empty containers of hazardous materials shall be stored in a designated area on site for regular removal and disposal by a registered contractor. All other wastes generated during site preparation and construction and operations shall be transported by the contractor or a company that has been specifically contracted to an authorized disposal area.
- Fuel handling and oil spill measures shall be implemented to prevent, control and address spill or leaks during construction and operations. Fuel and oil handling shall be assigned to trained personnel and done at designated places at the contractor's camp in accordance with relevant standards set by the Energy Regulation Board and Uganda Bureau of Standards.
- The weir structure shall be designed in such a way that small floods with minimum peak of 11.2 m^3/s and large floods of minimum peak flow of 15.3 m^3/s let to be conveyed downstream for environmental functionalities especially in flood plains during design and construction.
- The changes in physical chemical conditions of the reservoir and downstream of the dam site will have to be monitored and water flow adjusted according to EFR to reduce or eliminate any serious negative effects of the dam filling on the physical and biological aquatic systems.
- Environmental flow of 0.64 m^3/s for low flow regimes and a one in two-year flood of 13m^3/s of River Kiruruma shall be adopted and monitored.

- Efforts shall be made to protect water catchment areas upstream by restoring degraded wetlands and riverbanks, through community collaborative groups during construction and operation.
- Provide extension services to the host communities to diversify their agricultural activities and thence income, to reduce encroachment on wetlands and riverbanks during construction and operation.
- Undertake compliance assistance and sensitization of communities on benefits of sustainably utilizing and managing natural resources (wetlands, riverbanks, forests, etc.) during construction and operation.
- Periodic release of water or recharging of the rivers in line with set flows (Table 5-70) be done to keep the processes and survival of biota in the downstream areas during operation.
- Maintenance and protection of swamps to allow for continued ecological services including feeding, breeding and nursing of both aquatic and terrestrial wildlife. The wetlands will be protected against reclamation and/or being overflooded during construction and operation.
- Provide alternative safe water sources especially piped water supply and sensitize about prevention of water related diseases during construction and operation.

Impact Mitigation Enhancement

✓ Constant community and farmers sensitization on water pollution specifically regarding use of pesticides and fertilizers.

✓ Continuous monitoring of air quality against regulated emissions, such as draft NEMA's air quality standards in the construction phase.

✓ Farmers be advised to purchase MAAIF and UNBS approved agrochemicals from licensed agrochemical shops. They shall also use the chemicals in recommended application rates.

✓ Continuous monitoring on application of fertilizers and pesticides in the command area by local government agricultural officers/ engineers in the operational phase.

✓ Use of fertilizers and pesticides meeting required standards, such as International Code of Conduct on Pesticide Management in adherence to the national Control of Agricultural Chemicals Act, 2010.

✓ Deployment of a contractors Soil Erosion Control Management Plan (SECMP) and Spill Management Plan (SMP) to alleviate water pollution impacts.

✓ The designation of flood plains may also be a useful measure that allows groundwater recharge in the command area and reduces peak discharges downstream.

✓ Train farmers on purchase of right agrochemicals, their safe transportation, storage, safe application, and proper disposal of used and contaminated containers.

✓ Support local farmer cooperatives to supply agro-chemicals and seeds.

✓ Promote ecologically friendly agricultural farming: organic and climate-smart agriculture, Community Supported Agriculture (CSA).

✓ The project shall acquire water abstraction permits with conditions to guide the amount of water to be abstracted as stipulated in the Water Supply Regulations (1999). Water abstraction will comply with rates allowed by the DWRM permit that will be obtained.

- ✓ Removal of debris and minimizing of cutting of vegetation prior to filling of the reservoir to avoid extensive rotting and enrichment of the waters.
- ✓ There shall be continuous survey and assessment of the water reservoir and downstream conditions and communities while filling of water reservoir to allow for exit route (migration) of displaced species further downstream or facilitated movement of such forms to more appropriate habitats within the catchment.

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Medium	High	Major 12
Residual Impact	Low	Very Low	Minor 3

7.2.3 Risks of conflict due to water use reallocation

It is anticipated that there will be risks related to water use reallocation during the operation phase of the project.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
			√

Impact Evaluation:

The community will be exposed to risks of water reallocation during the operational phase. These risks associated with water reallocation may include:

1. Equity Concerns:
    - Conflict among users: Reallocating water will create conflicts between upstream and downstream users, small-scale farmers, and large agribusinesses.
    - Vulnerable groups: Vulnerable groups, such as smallholders, elderly, women, disabled, etc., who could be currently using the water may lose access to water resources, affecting their livelihoods.

2. Social Risks:
    - Loss of community cohesion: Water reallocation may disrupt traditional water-sharing practices and create divisions within communities.

Mitigation Measures

To mitigate these risks, MWE will engage stakeholders, implement equitable water allocation policies, and integrate sustainable water management practices into the irrigation project.

7.2.4 Air Pollution

Air pollution in this context is the generation or release of pollutants (harmful or excessive quantities of substances) into the project area's atmosphere that are; detrimental to community and workers health, environmental degradation and climatic change.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: The project community, contractor, project biodiversity (Impact Receptors) will be exposed to air pollution during both scheme construction and operational phases.

During pre-construction, construction and Dam filling, it is anticipated that during scheme construction, there will be an increase in road traffic associated with material and equipment haulage, these may generate both exhaust emissions and fugitive emissions. Exhaust emissions will mainly be from all fuel powered construction equipment such as vehicle fleet, concrete mixers, excavators, generators. Such emissions may include; carbon-dioxide, carbon-monoxide, nitrogen oxides, sulphur oxides, methane volatile organic compounds as well as particulates. Whereas fugitive emissions will result from generated dust particles of varying sizes from visible to invisible at haulage and excavation. The smaller the particle, the longer it stays in the air and the further it can travel. Fine dust particles are more likely to penetrate deeply into the lungs while ultrafine particles can be absorbed directly into the blood stream. Large dust particles fall out of the air relatively close to where they are created.

During operation; it is anticipated that the command area will bear non-point sources of pollutants mainly due to application of pesticides, fertilizers and burning in the command area. These are the major anthropogenic source of the greenhouse gases methane and nitrous oxide. Pollution from fertilizers or application of pesticides occurs when these are applied more heavily than crops can absorb or blown off the soil surface before they can be incorporated. Release of ammonia in the project atmosphere, cumulatively in excessive quantities, may attribute to acid rain, which damages trees, acidifies soils, lakes and rivers, and harms biodiversity. Burning of plant biomass is another major source of air pollutant, including carbon dioxide, nitrous oxide and smoke particles.

Impact Significance: Given that the project during construction phase, its anticipated that, 57 fleet will be deployed, characterised with numerous journey plans/ travelled routes and 30 construction fuel powered equipment's which may cumulatively generate total suspended particles (dust particles) of not more than 300 µgN m^{-3} (considering average baseline of 86 µgN m^{-3}) and trigger ppm or µgN m^{-3} of toxic and explosive gases above the draft NEMA's air quality standards (Appendix G) respectively. However, during operational phase, the anticipated emissions of toxic and explosive gases from the pesticides, fertilizers and burning from the entire command area (9000 Ha) may be below the cited standards. The likelihood of occurrence of this impact is short-term, localised in spatial extent during construction phase, whereas operational phase, it will be long-term covering a district extent, hence rating a ***Medium*** impact intensity.

In case of receptor exposure to the impact, it's anticipated that;

i. The dust particles will form the dust layers one can see on things like coating/soiling of property, coating of vegetation, furniture, nearby buildings and motor vehicles, stain households and goods in roadside shops. Although never compensated, staining of trade commodities in shops (especially foodstuffs: salt, sugar, flour, etc.) with dust translates into a financial loss for local business owners.
ii. Large dust particles may be trapped in the nose and mouth when one breathes them in and can be readily breathed out or swallowed harmlessly. Smaller or fine dust particles are invisible. Fine dust particles are more likely to penetrate deeply into the lungs while ultrafine particles can be absorbed directly into the blood stream. The type and size of a dust particle determines how toxic the dust is. However, the possible harm the dust may cause to health is mostly determined by the amount of dust present in the air and how long one is exposed to it. Dust particles small enough to be inhaled may cause: irritation of the eyes, coughing, sneezing, hay fever, asthma attacks. For people with respiratory conditions like asthma, chronic obstructive airways disease or emphysema, even small increases in dust concentration can make their symptoms worse. Excessive dust in dwellings poses a short-term health impact.
iii. Acute effects of diesel exhaust exposure include; allergies, hay fever, irritation of the nose and eyes, lung function changes, respiratory changes, headache, fatigue and nausea. Chronic exposures are associated with cough, sputum production and lung function decrements. In addition to symptoms, exposure may cause inflammatory changes in the airways, notably, before changes in pulmonary function can be detected.
iv. Obscure the vision of drivers to which dust clouds are a traffic hazard.
v. Penetrate nearby homes and become a nuisance.
vi. Increase wear on moving parts of a vehicle by fine abrasive particles.
vii. Loss of a road binder, in the form of dust, represents a significant material and economic loss.

Hence rating ***Medium*** impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Moderate*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Safeguards; Efforts to combat air pollution will contribute to SDG 3 (good health and well-being), SDG target 11.6 on air quality in cities, SDG target 11.2 on access to sustainable transport and SDG 13 (climate action), as well as the goals of the Paris Agreement on climate change.

Mitigation Measure for Exhaust Emissions

- Select low emission equipment and those with low fuel consumption as much as practicable.
- Use well-maintained vehicles and machines and undertake regular maintenance of equipment and vehicles, according to manufacturers' specifications.
- Shut down equipment when not in use to minimize idle time.
- As far as possible, source material from locations close to the construction sites to reduce haulage distances.
- Regularly servicing of all contractor's machinery to optimum working conditions to minimize potential emissions.
- No open burning of waste practice shall be adopted.
- Reduced or no use of pesticides/fertilizers through manual weed removal, placing traps and lures, removing pest breeding sites, growing more resistant plants, cropping native species that are naturally more resistant to native pests and supporting biocontrol agents such as birds and other pest predators.
- Use of sustainable fertilizers and pesticides.
- Proper application of sustainable fertilizers and pesticides, through following labelled directions, use of appropriate PPE and monitoring the weather when applying pesticides (avoid very hot or windy days).

Mitigation Measure for Dust Generation

- Covering of trucks delivering materials with tarpaulin to reduce the risk of fugitive dust emissions, especially in busy trading centres.
- Adoption of suitable controls for exposed stockpiles and unsealed construction areas (for example covering or spraying with water as appropriate).
- Limited vegetation clearing to the minimum shall be required for safe construction to minimise exposed areas and vegetation removal.
- As far as possible, water for construction activities shall be sourced close to the project site to reduce haulage distances, and therefore the exposure to the dust.
- Drivers shall be sensitized, emphasising the need to stick to designated routes and speed limits.
- Optimize the logistics to maximize use of available vehicles, and therefore reduce number of trips.
- A Dust Management Plan shall be drafted by the construction contractor.

Impact Mitigation Enhancement

- ✓ Constant community and farmers sensitization on air pollution specifically regarding use of pesticides.
- ✓ Continuous monitoring of air quality against regulated emissions, such as draft NEMA's air quality standards in the construction phase.
- ✓ Continuous monitoring and capacity building on application of fertilizers and pesticides in the command area by local government agricultural officers/engineers in the operational phase.
- ✓ Use of fertilizers and pesticides meeting required standards, such as International Code of Conduct on Pesticide Management in adherence to the national Control of Agricultural Chemicals Act, 2010.

- ✓ Local weather stations often shall post local air quality information and weather forecast for the sub-counties.
- ✓ Deployment of a contractors Dust Management Plan (DMP) and Spill Management Plan (SMP) to alleviate air pollution impacts.

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Medium	Medium	Moderate 9
Residual Impact	Low	Low	Minor 4

7.2.5 Noise Pollution

Noise pollution in this context is unwanted or excessive sound generated from project activities that can have deleterious effects on project community health and environmental quality.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	

Impact Evaluation: The project community (mainly site neighbouring schools), project area fauna and contractor (Impact Receptors) will be exposed to noise pollution during scheme construction. Project pre-construction and construction phase is anticipated to be associated with many noise generating activities such as;

(i). Movement of 87 construction vehicles and machinery including: trucks, concrete mixer, excavators, graders and dump trucks
(ii). Construction civil works like mixing concrete and welding
(iii). Offloading and loading of equipment and material at site
(iv). Conversations between workers
(v). Frist flash release of water into the network distribution
(vi). Transportation of material and equipment's to and from site

These will generate sounds alien to the area which could be a nuisance to the receptors around the construction site.

Impact Significance: Sound waves are vibrations of air molecules carried from a noise source to the ear. Sound is typically described in terms of the loudness and the pitch of the wave. The project site is currently experiencing an average of 46.9 – 58.4 dB (A) (Chapter 5: Table 5-5). It's anticipated that noise levels at source construction site may rise up to 90 dB, whereas along canal construction site (9000 command area extent) it may rise up to 75 dB due to low equipment deployment in relation to the source construction site. Cumulatively the project generated sound may exceed the regulatory noise limits for a construction site in a

commercial area (75 dBA) and that in a residential area (60 dBA) as provided for by the National Environment (Noise Standards & Control) Regulations, 2003. While noise levels may be severe at site, it will be short term (only during construction phase), localised in spatial extent at source construction site and covering a district extent for canal construction sites, hence rating a ***Low*** impact intensity.

The normal human ear can detect sounds that range between 0 dB (hearing threshold) and about 140 dB, with sounds between 120 dB and 140 dB causing pain (pain threshold). Noise from construction activities may be a nuisance to the neighboring receptors, since at certain levels and durations of exposure can cause;

i. Physical damage to the eardrum and the sensitive hair cells of the inner ear and result in temporary or permanent hearing loss. Hearing loss does not usually occur at SPLs below 80 dBA (eight-hour exposure levels are best kept below 85 dBA), but most people repeatedly exposed to more than 105 dBA will have permanent hearing loss to some extent.
ii. Blood pressure and pulse rates due to excessive noise exposure.
iii. Irritability, anxiety, and mental fatigue interfere with sleep, recreation, and personal communication.
iv. Disturbance of lessons of neighbouring school (Chapter 5: Table 5-26) resulting to low student concentration as students try to look for the noise source.

Receptor exposure effect will decrease with distance from the noise source, hence rating a ***Medium*** impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Moderate*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- Construction activities shall be maximised during school holidays and daytime.
- Hoarding/screening of noisy activities
- Regular care and maintenance of vehicles and equipment shall be undertaken to ensure they run smoothly so as to minimize emissions of noise.
- Where applicable, equipment shall be fitted with silencers to reduce noise.
- Project machines shall be turned off when not in use.
- Workers who may unavoidably have to work with noise generating equipment, e.g., earthmoving equipment, shall be provided with appropriate PPE, such as ear plugs.

Impact Mitigation Enhancement

- ✓ The contractors on site shall be made aware of, and adhere to, the regulatory noise limits for a construction site in a commercial area (75 dBA) and that in a residential area (60 dBA) as provided for by the National Environment (Noise Standards & Control) Regulations, 2003.
- ✓ Deployment of a contractors Noise Management Plan (NMP) and Traffic Management Plan (TMP) to alleviate Noise pollution impacts.
- ✓ Continuous project activities awareness to the community especially site neighbouring schools.
- ✓ organize noise generating works outside the school hours to the extent possible

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Low	Medium	Moderate 6
Residual Impact	Low	V. Low	Minor 2

7.2.6 Degradation of soils and soil erosion

Soil degradation impact in this context is the physical, chemical and biological decline of the soil quality in the project area. It can be the loss of organic matter, decline in soil fertility, and structural condition, erosion, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemicals, pollutants, or excessive flooding.

Simulations of soil erosion were conducted and the estimates of rate of soil erosion are shown in Figure 7-1. The worst-case scenario considers a situation where deforestation continues and there are no erosion control practices in agricultural areas.

Figure 7-1 shows the derived erosion rates for different land cover types.

Table 7-1 Erosion rate for normal conditions (current) and worst case (deforestation with no conservation practices)

Land cover	Area under land cover (km2)	Erosion rate (ton/km2/year)	
		Normal case	Worst case
Closed Bushland	8.0	94.52	254.03
Closed Grassland	5.8	48.71	144.10
Dense Natural Forest	2.3	70.00	144.44
Moderate Natural Forest	1.5	51.77	119.96
Open Bushland	22.3	63.51	161.41
Open Grassland	1.6	78.25	395.39
Settlement	0.8	87.94	218.40
Subsistence Cropland	91.9	250.60	539.63

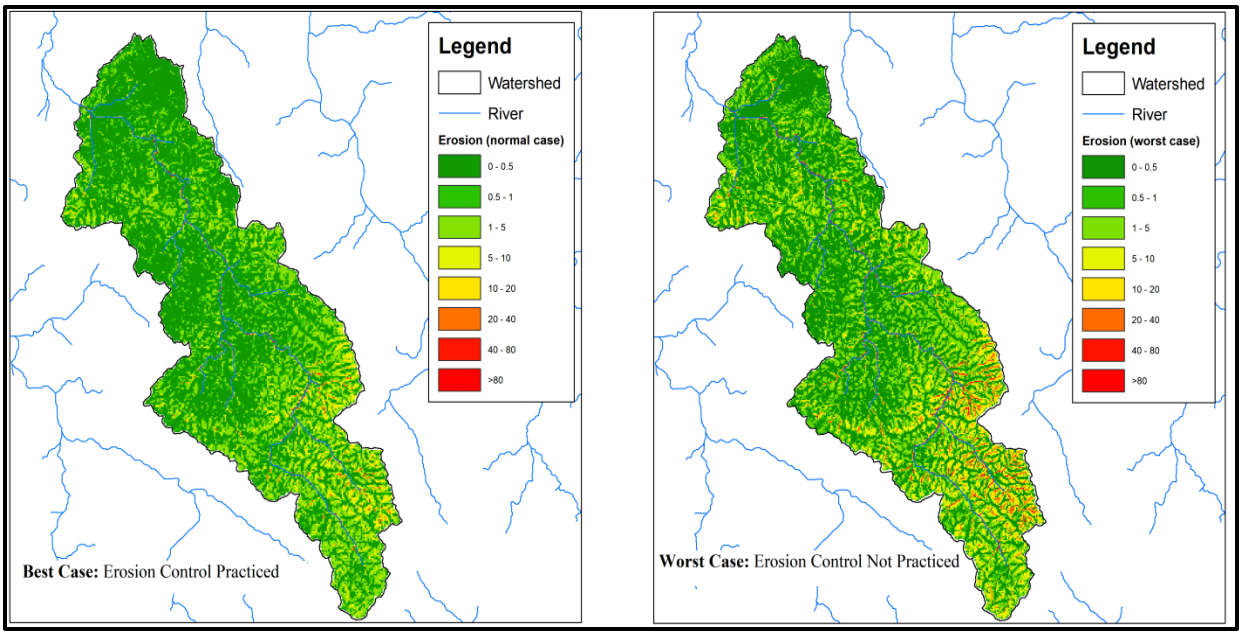


Figure 7-1 Erosion rates (ton/ha/year). Normal case scenario (left), worst case scenario (right)

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: The project area; soils, drainage, and flora, command area soils and downstream biodiversity (Impact Receptors) may be exposed to soil pollution/ degradation during scheme pre-construction, construction and operational phases.

During pre-construction, construction and Dam filling, it is anticipated that during scheme construction, there will be a risk of soil contamination associated with the construction activities;

- Cleared surface vegetation and soil during grubbing and stripping could cause erosion. Erosion would have effects like loss of huge volumes of topsoil nutrients for agriculture, washing of oil contaminated soils to neighbouring gardens or water systems.
- Uncontrolled spillages of fuels, lubricating, paints, solvents, and hydro-testing chemicals. Oils and greases contain hydrocarbons and/or heavy metals such as lead, chromium and cadmium, which are known domestic pollutants.

During operation, many of the current agricultural practices used in growing crops in the command area pose a risk to the loss of topsoil and destruction of soil characteristics that make agriculture possible in the arable land. It is anticipated that the command area will bear non-point sources of pollutants mainly due to application of pesticides, fertilizers in the command area. Pollution from fertilizers or application of pesticides occurs when these are applied more heavily than crops can absorb, hence end up being leached in the soil. Also, the overuse of some agrochemicals changes soil composition and disrupts the balance of microorganisms in the soil. This stimulates the growth of harmful bacteria at the expense of beneficial kinds.

Impact Significance: Deterioration of soil quality would arise from erosion where the top and productive soil layer is washed away or from leaching of minerals from the stockpiled soil at site during rains. The steep sloping terrain makes soil erosion and sedimentation likely impacts. In addition, compaction activities would affect soil texture, its transmissivity and ability to hold moisture. Incidents and activities having potential effect on soil quality are anticipated to occur during the site preparation where strips of vegetation are cleared, and soils heaped or stored. Soils excavated may be stored at the project sites hence exposure to agents of erosion such as wind and storm water. The likelihood of occurrence of this impact is short-term, localised in spatial extent during construction phase, whereas operational phase, it will be long-term covering a district extent, hence rating a ***Medium*** impact intensity.

The effects of soil erosion go beyond the loss of fertile land. It can lead to increased pollution and sedimentation/ increase in turbidity in River Kiruruma and neighboring streams, clogging project area waterways, altering how water flows through the landscape and causing declines in fish and other species. Degraded soils are also often less able to hold onto water, which can worsen flooding. Also, the loss of fertile soil from the command area could make the scheme less productive for agriculture. However, the 4420 Ha command area has been delineated into blocks, hence contamination spread will be controlled, rating a ***Medium*** impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Moderate*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- Clearance of vegetation shall be limited to areas that will be required for construction of the components. This will serve to minimize land disturbance as much as possible.
- Excavated material shall be collected routinely such that heaps of exposed soils are not left in the project area for long.
- Topsoil and subsoil removed from the site during site preparation shall be stored properly (away from runoff and possible contaminants) for reuse elsewhere or for backfilling and reinstatement.
- Heaps of excavated soil shall be covered with tarpaulin to minimize exposure to agents of erosion such as wind and running water.

- Contractor shall avoid use of old equipment and damaged equipment that is most likely to have oil leakages thus contaminate the soils and the contractor shall ensure that equipment is properly maintained and fully functional to avoid leakages that may contaminate soils.
- During reinstatement, the trench back-fill material shall be compacted to a level similar to the original surrounding soils to avoid subsidence as a consequence of rainwater channelling.
- All waste generated during site preparation and construction shall be transported to an authorized disposal area. The contractor will seek guidance from the Kanungu District Local Government of the respective project areas on the final disposal point.
- A Spill kit shall be maintained onsite to clean-up any accidental spills.
- Retention ditch shall be provided such that runoff from the project site does not go directly into neighbouring gardens or drain into the underground source.
- All areas with contaminated materials shall be protected by a securely fenced-off exclusion zone.

Impact Mitigation Enhancement

✓ Sustainable land use can help to reduce the impacts.

✓ A waste management plan will be developed prior to start of construction activities.

✓ Constant community and farmers sensitization on soil contamination specifically use of pesticides.

✓ Continuous monitoring of soil quality against emissions, such as draft NEMA's air quality standards in the construction phase specifically at the water abstraction site.

✓ Continuous monitoring on application of fertilizers and pesticides in the command area by local government agricultural officers/ engineers in the operational phase.

✓ Use of fertilizers and pesticides meeting required standards, such as International Code of Conduct on Pesticide Management in adherence to the national Control of Agricultural Chemicals Act, 2010.

✓ Any excavation, transportation or disposal of contaminated soil must be carried out in accordance with local regulations and must be sure to procure all the relevant licenses and pay any fees due.

✓ Deployment of a contractors Soil Erosion Control Management Plan (SECMP), Waste Management Plan (WMP) and Spill Management Plan (SMP) to alleviate soil pollution impacts.

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Medium	Medium	Moderate 9
Residual Impact	Very low	Low	Minor 2

7.2.7 Social Misdemeanour by Workers

Social misdemeanour in this context is the social evils/ wrong doings that are attributed by the project, specifically its employment of foreign workers alien to the project area.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: Project community (Impact Receptors) characterized with a defined social, cultural, economic setting will be exposed to project activities in all phases.

During pre-construction, construction and Dam filling, both skilled and unskilled job opportunities for residents in the project area, Ugandan nationals and internationals, especially the youths will be availed. Skilled labour will include artisans such as engineers, plumbers, carpenters, masons while unskilled labour will include trenches for the closed pipe line network distribution excavators. Many of these are coded as Mobile people by the community, "mobile men with money". Whereas during the operation phase, long-term technical and non-technical job opportunities for professionals (engineers that will maintain the system), casual labourers (farmers) will be available to operate and maintain the scheme. While most workers (construction crew and cultivators for respective phases) may originate from the local community where they have families, there might be others from distant places and working away from their families. These will be alien to the community or Kanungu District or Region or National environment and social setting.

Impact Significance: entry of the above foreigners in the project area in search for work, will;

i. Reduce local-local content as some filled positions by them will be lost by the community
ii. Increase their disposable income visa via that of the locals
iii. Intrusion of new culture, depending on origin and ethnicity
iv. Intrusion of new policies, depending on contractors' organisational structure

For project workers originating from the community, it is anticipated that there may be increased risks of theft (since they are vaster with the local setting) and low work performance (most construction sites, workers tend to come late, go back to their families at any time of the day, loss of work concentration due to community programs such as events since they are in the project vicinity). Basing on the fact that construction projects of such magnitude attract high numbers of casual labourers, it is anticipated that biggest percentage of casual labourers will comprise of local/community people (in both phases). The likelihood of occurrence of this impact will be high and felt in a short-term during construction phase, whereas during the operational phase, it will be long-term, hence rating a ***Low*** impact intensity.

Given the population density within the area (average household size for the Kanungu District is 4.7 persons), interaction between the residents and workers will also be inevitable. In some cases, the workers may choose abode within the communities in which they are working to avoid long commutes from their homes. This social interaction between the workers and the community could result in;

(i). Fraternization that could be sexual. Induce illicit sexual relationships, with attendant risk for spread of HIV/AIDS and other STIs. Irresponsible sexual relationships in project communities can break families and heighten risk of contracting HIV/AIDS/other STI.
(ii). Sprout of other diseases, such as Hepatitis B, cholera, but a few due to induced sanitation culture in the community.

(iii). In local communities, construction workers are lionized as richer with ready income to spend. This together with influx of workers, typically young youth seeking construction job opportunities could lead to an increase in social pathologies such as alcohol or illicit drug abuse and prostitution.

(iv). Cultural degradation such as, dressing code, respect of elders.

(v). Increase of sexual exploitation abuse as many community women may be attracted to the workers that have disposable income to spend with aim of sustaining their families, rape and defilement are also anticipated.

(vi). Increase of Violence against Children (VAC) and Gender Based Violence (GBV), due to increased income levels of the men working on the projects, in turn increased alcohol consumption rates which turn triggers increased wrangles at home. Also, workers might engage in sexual acts with underage children particularly the girl child. This may result in early age pregnancies and an increase in number of girl children school dropouts. This may psychologically disorient the life of the child and her family.

(vii). In addition, consultations with the community revealed fears of family breakages and promotion of promiscuity among married couples, since the women will be easily enticed by the project workers that have ready income to spend. This in turn may lead to an increased spread of communicable diseases especially HIV/AIDS.

(viii). The influx of new people in the project area comes with all sorts of vices including stealing project materials and equipment. Such unscrupulous people may involve the local community members and project workers in their activities which in the long run might affect the quality of the works. Security threats such as theft can lead to loss of construction materials such as stones, and cement bags, that in turn may lead to delay in work progress, shortage of materials and contractor's capital and above all failure to complete work.

Most of the negative effects that result from social misdemeanour trigger non complacencies with community and Kanungu District bylaws, national legal framework, such as; National Gender Policy, 1997; HIV/ AIDS Policy, 1992; The Constitution of the Republic of Uganda, 1995; Children's Act, Cap 59- 2016; Penal Code Act, Cap 120- 2007; Public Health Act Cap 281-1935, but a few, rating a ***High*** impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Moderate*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- All construction workers will be sensitized about responsible sexual behaviour with the communities.
- The contractor will be required to develop and operationalize a policy against sexual exploitation, abuse, and harassment (SEAH).

- Workers shall be required to sign a code of conduct.
- Workers prohibited from interaction with the school students.
- The contractor shall follow up any grievances from the community and the schools.
- Conduct background checks on all people before employment.
- Hire security guards from a registered company that have records of each guard, to protect both the contractor and the project site.
- Collaborate with the local administration including LC1s, police post and Kanungu District police station.
- "No Trespassing" signs will be prominently displayed on fencing or the perimeter of the job site. Such signs will discourage unauthorized intrusion onto the job site and if correctly worded aids in the prosecution of apprehended trespassers.
- Ensure stakeholder involvement and participation in all project stages.
- Ensure transparency in electing community committees e.g., project management committees through open nomination and/or voting mechanisms.

On top of the above mitigation MWE will hire a GBV consultant to handle issues of GBV/SEA/SH during implementation of the project.

Impact Mitigation Enhancement

✓ Continuous sensitization of both the workers and the community of the evils of social misdemeanour.

✓ Deployment of contractor's code of conduct.

✓ The contractors on site shall be made aware of, and adhere to community and Kanungu District bylaws, national legal framework on social and health conduct.

✓ Deployment of a contractors Labour Management Plan (RLP), Cultural Plan, and Gender Mainstreaming Plan, HIV/AIDS Plan, Community Liaison / Engagement Plan, and Grievance Management Plan to alleviate impact of social misdemeanour.

✓ Provide regular extension services such as training the various community and farmer groups on basic management approaches and resolution of conflicts/ differences.

✓ Accommodate most of the migrant workers in camps to minimize interaction with the host communities.

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Low	High	Moderate 9
Residual Impact	Very Low	Medium	Minor 3

7.2.8 Management of generated waste

Construction waste is unwanted material produced directly or indirectly by various construction activities.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: Contractor and Project; community, biodiversity, water sources, atmosphere (Impact Receptors) characterized will be exposed to project activities waste in all phases. It's anticipated that a number of wastes will be generated, ranging from construction wastes, hazardous wastes to domestic wastes, including:

(i). Vegetation waste from site clearance.
(ii). Excavated materials from earthworks (e.g., cuttings, re-grading works).
(iii). General construction waste (e.g., wood, scrap metal, concrete, empty cement bags).
(iv). Municipal wastes generated by site workers (plastic bottles, mostly drink/ water bottles), paper, cloths, food scraps, sewage).
(v). Hazardous waste generated from fertilizer and pesticides application in operational phase (solvent containers) and used oils in the construction phase.

Impact Significance: Given that the project will involve construction activities, such as; clearing of site, excavation of trenches for the closed pipe line network distribution, civil workers, utilization of workers camp, servicing of construction equipment's, temporary stockpiling or storage on site, transportation, but a few, and operational phase will involve use of fertilizer and pesticides, various quantities of waste will be generated, making the likelihood of occurrence of this impact is high. In spite the fact that impact may be localised for short term (lasting the period of construction) in the construction phase, it will be cumulatively felt permanently under both district and regional extent in long term if the waste ends up into the River Kiruruma, hence rating a ***High*** impact intensity.

Waste generated in both phases if not properly managed will have the following negative impacts to the receptors.

(i). Heap of collected rubbish pose a nuisance due to poor aesthetics (visual impact).
(ii). Associated with bad odour (air pollution).
(iii). Harbour disease causing vectors like flies (impact on health).
(iv). Contaminate the soil or the environment on which it seats (soil pollution).
(v). Cause water pollution.
(vi). Accidents like cuts from sharp objects.

Hence noncompliance to National Environment (Waste Management) Regulations, 1999 in response to such attributing effects to the receptor, Impact sensitivity is rated ***Medium***. The product of both impact intensity and receptor sensitivity, rates a ***Major*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- All materials shall be re-used or transported off site as soon as possible to minimize the potential for adverse environmental impacts. It is recognized that some stockpiling of materials will be required in some instances although these shall be segregated in terms of material type as far as practical to facilitate material re-use (i.e., topsoil for landscaping, suitable fill for engineering works).
- All excavated material shall be handled in a manner that minimizes the release of fugitive dust (especially during hot and dry weather) and where possible the movement of material shall be kept to a minimum.
- The contractor will be obligated to ensure responsible waste management, for example collection of waste by an approved waste contractor who will dispose of waste to a licensed area/ landfill.
- Waste shall be collected, sorted and temporally stockpiled in a designated area before haulage off site.
- Waste minimization will be emphasized and implemented throughout this stage of the project.
- Avoiding and/or minimize waste generation where practical by improvements or changes in the project design or site procedures.
- The principles of an integrated solid waste management system shall be implemented i.e., reduction at source, reuse and recycle. This shall be implemented by use of accurate estimates of dimensions and quantities of materials required, use of durable materials that will not require replacement often, providing proper facilities for handling and storage of construction materials to minimize waste by damage.
- Waste transportation vehicles shall be covered to avoid spillage or waste getting blown off during haulage.
- Waste will be removed from the site in a manner consistent with national regulations (for example, transporters will be licensed). While transporting waste, care shall be taken to prevent waste spreading to areas outside the site boundary.
- Construction workers shall be provided with appropriate protective gear during handling of waste.
- Consider maximizing the re-use of excavated materials for example, within landscape mounds.
- Provide an area within the construction site to allow for sorting and segregation of materials.
- Material shall be covered during heavy rainfall.
- Using dust suppression techniques (such as dampening with fine water spray and covering with tarpaulin).
- Locating stockpiles to minimize potential visual impacts.
- Provide fencing within designated areas to separate sensitive habitats and prevent stockpiling in unsuitable locations; and designate appropriate haulage roads.

Impact Mitigation

- Before the commencement of the project, the contractor shall develop and implement a Waste Management Plan (WMP) for the project. The WMP shall be consistent with the waste legislation of Uganda and other national and international best practices. The WMP shall be a conclusive approach to manage all waste components in accordance with the best health, environmental, economic and engineering practices (and responsive to public attitudes). The WMP shall will be developed on the basis of the Waste Management Hierarchy

- Constant community and contractor's sensitization on waste management.
- Continuous monitoring and annual Environmental and Social Audits of contractor's waste management practises against National Environment (Waste Management) Regulations, 1999 and the World Bank OP 4.01 in the construction phase.

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	High	Medium	Major 12
Residual Impact	Low	Low	Minor 4

7.2.9 Occupational Health and Safety

A. General Project Occupational Health and Safety Risks

Occupational Health and Safety in this context is the safe wellbeing of contractor's worker force (pre-construction and construction) and command area cultivators in the operational phase.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: Contractor's worker force and command area cultivators (Impact Receptors) may be exposed to Occupational Health and Safety risk.

During pre-construction, construction and Dam filling, Construction traffic, excavation machinery, slippery roads, civil works in trenches, lifting heavy materials, may tasks pose accident risk to workers either when equipment is operated by inexperienced workers or when in a poor mechanical condition or falls into the trenches or due to speeding traffic.

Risks associated with occupational diseases could be as a result of;

- Carrying of loads (Ergonomics/ musculoskeletal disorder).
- Exposure to physical agents at worksite, including Noise and Dust (pneumoconiosis).
- Exposure to biological agents at worksite, especially contact with infected personnel; workers or beneficially members and infected surfaces (Communicable diseases such as COVID19, Hepatitis B). Basing on the present global pandemic situation (2020), influx of workers in the project area, may increase the risk of COVID19 exposure to the community members, since its perceived they may be originating from different parts of the country (which may be hotspot areas).
- Exposure to chemical agents at worksite, including hazardous chemicals.

The contractor shall be concerned with the issues of safety for several reasons including:

- Legal obligations imposed by OSH
- Contractual requirements
- Direct and indirect financial impact (profit picture)
- Corporate and personal legal liability (fiduciary duty)
- Ethical duty and moral obligation
- Public image and reputation

During operation; command area cultivators might experience negative health impacts, particularly during application of fertilizers and pesticides, fatal falls, and injury while working with various tools, such as hoes, pangs.

Mitigation Measures

Occupational health

i. The contractor shall undertake task based and place/location/area based risk assessments before carrying out the tasks or occupying the place/location or area.
ii. Pandemic Preparedness & Response Plan, tailored specifically for the project shall be prepared and implemented by the contractor.
iii. Screening all new employed workmen for syptoms of communicable diseases at recruitment.
iv. Maintaining regular housekeeping practices, including routine cleaning and disinfecting of surfaces, equipment, and other elements of the work environment.
v. Promoting frequent and thorough hand sanitizing, this will include providing workers, and worksite visitors with hand sanitizers in strategic locations and stocking of hand sanitizer liquids for refilling them.
vi. Ensuring that all project community engagements are conducted respecting social distancing.
vii. Purchase of appropriate personal protective equipment including face masks and ensuring that all staff are wearing full appropriate PPE.
viii. Encouraging all workmen to conduct self-monitoring for signs and symptoms of contagious diseases.
ix. Providing all workers with job-specific education and training on preventing transmission of any pandemic and other contagious diseases.
x. For all trucks delivering project material (consignments), through boarder points; truck drivers shall be requested to stay in truck cabin during entire stay at site; present any necessary pandemic test results

by MOH disease surveillance department for having been screened for symptoms, disinfection of entire truck carrier, and EHS giving clearance for offloading.

Occupational safety

i) All project workers shall have to bear a project identification.
ii) All workers shall undergo an induction before commencement of their activities.
iii) Toolbox meetings at construction site sections on safe work practices shall be conducted daily.
iv) Safety training shall be conducted routinely on how to prevent and manage incidences on site.
v) OHS signage that is clear and visibly displayed shall be used to warn off the project employees of dangerous areas such as deep trenches or slippery areas along the channels.
vi) Hoarding off the source construction site to put at bay any unauthorized person on site.
vii) Appropriate signage shall be used to warn staff and/ or visitors that are not involved in construction and operation activities in risky places.
viii) Providing of First Aid units fully equipped with the necessary materials; and train first aiders to administer it.
ix) Personnel shall only undertake tasks for which they are trained/ qualified. A formal 'permit to work' system shall be in place and strict instructions shall be given for operators of equipment.
x) Strict instructions shall be given to drivers of heavy equipment and operators of equipment/ machinery. Ensure electrical safety at fabrication workshops by having competent people handling specific section during construction and operation.
xi) Road traffic signs shall be installed on major access roads to control the speed of vehicles transporting people and material to the site.
xii) Supervision of works shall be done regularly (daily during construction and weekly during operation) to ensure that safety conditions are met while any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work.
xiii) Clear communication line shall be ensured between workers and operators/ drivers of heavy equipment.
xiv) The project contractors and sub-contractors shall be required to provide appropriate PPE for their workers to ensure that any risks are minimized to a level that is as low as reasonably practicable. Appropriate PPE shall be used by the construction workers to minimize the severity of accidents on site, if they occurred.

7.2.10 Dam Safety Risks

Dam safety concerns monitoring the state of the dam, including external physical threats to the dam (especially unusual events risks) and issuing emergency warnings at various degrees of automation during Dam operation. Dam Safety risk management is undertaken after the dam is commissioned for operation and maintenance. **Impact Evaluation**: Matanda Scheme dam and other appurtenant structures, downstream environment (Impact Receptors) may be exposed to such safety risk, including.

Risks	Determinants
Flooding beyond the reservoir elevation of 1140 m a.s.l.	Current reservoir water surface elevation; Observed water surface rise rate; Weather conditions in the vicinity-past, present, and predicted; Discharge condition of the stream above and below the reservoir; Known conditions at locations upstream or downstream from dam.
Slumping or cracking of the dam or abutment	Location; Size of affected area(s) in height, width, and depth; Extent (severity); Estimated discharge (whether clear or cloudy water).
Landslides that could result into rapidly displacing a large volume of water in the reservoir, which would be dangerous to dam stability	Size; Possible cause; Degree of effect on operation; Probability of additional movement of disturbed area or of other slide; Development of new slides; Capability of immediately closing outlet works; Other inflows; Location in relation to the toe of the dam and other appurtenant structures; Availability or need for heavy equipment.
Failure of appurtenances or operating equipment	Probable cause of failure, duration, and effects on reservoir operation.
New springs, seeps, or boggy areas	Location; Size of affected area(s); Estimated discharge; Nature of the discharge (whether clear or cloudy water); Reservoir elevation; Read data from all pertinent instrumentation.
Abnormal instrumentation readings, such as anomalies recorded during dam inspections	Possible reading or computation error or instrument failure; Calculate change in reading from normal; Reservoir elevation; Weather conditions.
Severe storms (heavy rainstorm, high wind, etc.)	Nature, location, and extent of possible damage.
Electricity and Fires	Location and extent; Possibility of fire spreading to or damaging dam facilities; Prevailing weather conditions; and Communications outage; Electric voltage.
Sabotage, or bomb attack	Security level, political environment, extent of damage.
Earthquakes	Location; Extent (severity); Rate of subsidence; Effects on adjoining structures; Springs or seeps; Reservoir elevations; Prevailing weather conditions.

Other dam safety risks include;

- Large or sudden releases into the downstream channel
- Drowning
- Criminal action involving project property.

Impact Significance: Given that the construction, the project environment will be characterised with both project works and labour force, whereas in operational phase it will be characterised with agricultural works and labour force, the likely interaction of the two is eminently localised for a short-term during scheme

construction and temporal during operation phase, with the following directly or indirectly felt occupational hazards;

- Direct costs include medical cost and compensation.
- Indirect/hidden costs include:
    - time lost from work by the injured party.
    - loss in earning power, economic loss to injured worker's family.
    - diminished quality of life for the injured party
    - loss of efficiency by breaking up crew
    - cost to train new or replacement employees.
    - damage to equipment and tools
    - loss of production
    - cost incurred by delays.
    - failure to meet contract demands (completion, etc)
    - overhead costs associated with disruption of work.
    - clean-up and repair costs
    - administrative costs of investigations and reports
    - loss of future project due to adverse publicity
    - cost of fines

Basing on such cited factors, impact intensity is rated ***high*.**

Different construction activity stages are associated with different hazards and they range from minor to fatal accidents once exposed to the receptor. Examples of these occupational hazards could be: -

(i). Excavation: - falls, injuries, dust inhalation
(ii). Work Shop: - burns, eye piercings, flames, wounds
(iii). Installation: - back aches, injuries
(iv). Community engagement, especially enumerators collecting data may be exposed to Communicable diseases.

In case of occurrence of this hazard (exposure to the receptor), there may be near misses or reportable lost time injury or dangerous occurrence or fatal cases which may have legal implication causing a delay in both implementation and operation of the scheme hence causing a temporal lag in the project time lines, rating ***Medium*** Impact sensitivity. The product of both impact intensity and receptor sensitivity, rates ***Major*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Dam Safety Operational Risks Mitigation Measures

i) Adopt scheme dam safety plan

ii) Thoroughly inspect for any damages on;

- Both dam faces for cracks, settlement, or seepage.
- Abutments for possible displacement.
- Drains and seeps.
- Spillway structure.
- Outlet works control house, shaft, and gate chamber.
- Power supply and standby power unit.
- Visible reservoir and downstream areas for landslides.
- Other appurtenant structures.
- Read critical instruments and note any abnormal or changed readings.

iii) Replacement parts and repair equipment

iv) Report immediately to Dam management unit

v) Conducting; immediate maintenance, required maintenance at earliest possible date and continuing maintenance on earthworks, riprap, vegetation, livestock control, rodent damage, traffic damage, electrical, concrete, metal components.

Impact Mitigation Enhancement

- ✓ The contractor's management shall give priority to Health, Security, Safety and the Environment.
- ✓ The contractor's management shall ensure that all employees, including subcontractors, are aware of their personal responsibilities in maintaining an accident free and healthy work environment.
- ✓ A qualified Health and Safety Officer shall be recruited by the contractor to oversee OHS matters on a daily basis and project safety committees shall be constituted.
- ✓ A workplace registration license shall be obtained from Ministry of Gender Labour and Social Development (Department of OHS);
- ✓ The contractor shall bear and implement a Health and Safety Policy and Standard Operating Procedures that will be explained during induction.

- ✓ The contractor shall have an approved Occupational Health and Safety Management Plan that will guide implementation and compliance to safety while on site for both the workers and the neighbouring community;
- ✓ The contractor's management shall ensure that safe working methods are adopted for hazardous operations;
- ✓ Deployment of a contractors Traffic Management Plan (TMP) to reduce project traffic related accidents
- ✓ Deployment of a contractors Environment Social, Health and Safety Plan (ESHSP) and Emergency Response and Incident Management Plan (ERIMP) to alleviate public safety risks.
- ✓ Deployment of project Grievance Management Plan (GMP) as to capture and handle worker safety reported risks.
- ✓ Empowering of scheme beneficiaries (farmers in the command area) public safety safeguard
- ✓ The contractor will bear the full accountability of creation of a safe environment for the project workers.
- ✓ Continuous monitoring, Job hazard Analysis, regular OHS Audits against OHS legal framework, such as; Occupational Health and Safety Act 2006, Employment Act 2006, Public Health Act Cap 281, Workers Compensation Act 2006, National Environment (Control of Smoking in Public Places) Regulations 2004, Traffic and road safety act, 1998, but a few in the construction phase.
- ✓ The Contractor shall report all accidents and incidents in a timely manner in line with the World Bank Environment and Social Incidents Response Toolkit (ESIRT) instructions and relevant templates for reporting by the Implementing Agencies. The ESIRT instructions and templates are presented in Appendix L of Volume II of the ESIA Report .

Residual Impact: Adoption of the above measures will reduce the impact to ***Moderate*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	High	Medium	Major 12
Residual Impact	Medium	Low	Moderate 6

7.2.11 Impact on Gender

Project gender inclusion in this context is the employment focus on women, youth, and local men and adoption of gender equality scheme related strategies in all phases.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: Women and girls (Impact Receptors) both working and living in the vicinity of the project.

During pre-construction, construction, and Dam filling, gender equity in the construction sector in Uganda seeks to strengthen women's participation and benefit from such projects. Along various site boundaries, women are commonly seen selling foodstuff and consumer goods in kiosks or roadside markets. Participation

of women in construction is a desired gender-related benefit but this may be constrained by the fact that most construction sites in Uganda are predominantly male dominated which disadvantages women involvement in provision of labor. However, for several Ugandan construction projects it has been observed that women perform more efficiently especially in materials analysis, supervision and in some cases machine operation. Project construction stage is anticipated to have the following potential gender impacts:

(i). There will be opportunity for women to sell meals and drinks to construction workers, which is a common positive impact for construction projects in Uganda.
(ii). Construction associated dust impact would equally affect both genders (men and women traders). This is a negative impact.
(iii). There will be opportunity for employing women during construction, a positive impact, although the number of women hired will likely be less than that of men for the reason that contractors consider women less suited for strenuous manual labour.

However, a gender-responsive approach would be to hire women in roles where they are best suited to handle.

During the operation phase, unlike the construction industry in Uganda, the agricultural industry, mainly, cultivation, harvesting is composed of women, therefore it's anticipated that most casual labourers (farmers, available to operate and maintain the scheme will be composed of women. There is also a possiblity of gender constraints and vulnerabilities like gender-based violence affecting poor women, youth, children headed households, older persons and disabled persons.

These include: a) v*ulnerability to market forces* resulting from new competition; price fluctuations of agricultural produce especially vegetables; b) climate change related vulnerability to hazards such as floods in downstream areas resulting from river overflow, as well as reduced adaptive capacity among the poor households.

Impact Significance: Given that the projects of this nature hire a smaller number of during construction;

(i). Less women will benefit from earned salaries, hence less improved community livelihood since many of the employed men counterparts will be miss using the earned income for social evils like prostitution, drugs, alcohol.
(ii). Those that are hired may be discriminated, face sexual harassment, gender-based violence, under payments, disrespect of women rights, physical handicaps.
(iii). Other possible hindrances to participation of women in construction employment are:
- Farming activities in rain seasons demand lot of garden work by women, which may impede their employment in construction.
- Married women may benefit less from construction employment because their spouses may dictate whether they work or not. This choice being solely a responsibility of an unmarried woman means that single women might benefit from construction phase jobs more than married women.

Also, during operation phase, in spite the women are the ones that do all the agricultural work, many may not realise the earnings since after they sell the produces, the men instead utilise the hard worked for earnings for their own benefit. Likelihood of this impact occurrence is high for both short term construction phase and long-term operational phase in the entire district extent as women look for employment so as to sustain their families and needs, rating a ***High*** impact intensity. In case of occurrence of this hazard (exposure to the receptor), there may be increased gender related cases; such as health issues (HIV/AIDs), marriage breakups, girl child school drop outs, early pregnancies, maternity deaths due to abortions, physical harm, stigma, loss of self-worth, rating ***High*** impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Major*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- To the extent possible, equal employment opportunity shall be available for women. Employment of women excluding girls below 18 years of age shall be considered. To effect this; the construction contractor shall encourage women to apply for available jobs. additionally, local council representatives working with the construction contractor on recruitment shall encourage women to apply for project jobs.
- During construction phase, women shall be involved in a wide range of activities including storekeeping, beautification/ landscaping, welfare of workers, site supervision and sweeping.
- The contractor shall use gender-sensitive language such as: “Go Slow, Work in Progress” instead of “Go Slow, Men at Work”. This, coupled with women’s visibility in construction works would contribute to women’s empowerment as well as breaking the stereotype that construction is a preserve of men.
- The contractor shall involve local leaders in recruitment process to ensure full and fair participation of local communities especially women and screening out of lawbreakers.
- The contractor shall be selective in awarding service contracts, giving preference to women-owned entities. This, for example, is in regard to preparation and supply of foodstuffs to workers on site.
- The contractor shall sensitise project workers about gender discrimination, gender-based violence and sexual harassment.
- Contractor shall be encouraged to pay an equal ‘living wage’ to all workers involved in project implementation including women on the same job posts.
- Both men and women shall equally involve themselves in scheme agricultural practices.
- Women, youth, men shall be allowed in the decision-making process of the both the strategic and daily activities of the scheme.

Impact Mitigation Enhancement

- ✓ The contractor shall put in place measures to respect human rights.
- ✓ The contractors shall be contractually required to use locally available labour, to the extent possible, depending on the level of skills required vis à vis what is available. This will have the advantage of enabling the local communities to work in the project especially women.
- ✓ The contractors shall be contractually bound to protect against gender-based violence by signing 'Code of Conduct for Contractors' that will carry hefty penalties upon breach of contract.
- ✓ Local area leaders in the project areas shallbe asked to allow time particularly for the discussion of issues related to the project during their regular village and committee meetings. Women will be allowed to voice their concerns and if necessary, hold focused group discussions to identify and deal with any issues of gender-based violence.
- ✓ Continuous sensitization of both the workers and the community of about gender inclusion, non-descrimination and women empowerment.
- ✓ Deployment of contractor's code of conduct.
- ✓ The contractors and their personnel and workers on site shall be made aware of, and adhere to community and Kanungu District bylaws, national legal framework guiding women inclusion and their rights protection, such as; Occupational Health and Safety Act 2006, Employment Act 2006, Public Health Act Cap 281, Workers Compensation Act 2006, but a few in the construction phase;
- ✓ Deployment of a contractors Labour Management Plan (LMP), Cultural Plan, and Gender Mainstreaming Plan, HIV/AIDS Plan, Community Liaison / Engagement Plan, and Grievance Management Plan for gender inclusion.
- ✓ Support community groups (women, youth, disabled persons, older persons) with production inputs as a measure of production safety nets and livelihood restoration activities.

Residual impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	High	High	Major 16
Residual Impact	Very low	Medium	Minor 3

7.2.12 Flooding

Due to the construction of dam, some houses and roads are getting submerged in the reservoir. The number of houses and length of roads submerged at various dam heights are as follows.

Table 7-2: Houses and Length of Roads Submerged by the Reservoir

Scenario	FRL	Height of Dam	No of Houses	Roads
	(m)	(m)	No	m
Scenario-A	+1259	20	9	1800

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
		√	√

Impact Evaluation: Command area and upstream the dam (Impact Receptors) will be affected due to project setup.

Impact Significance: Given that the project will involve construction of major hydrological infrastructure at the source (Roller Compacted Dam), closed pipeline network distribution stretching in the command area of (4420 Ha covered by the current pipe network design) which covers (5) sub counties (district extent), the likelihood of occurrence of this impact is high and permanent. However aggregative estimate of land take may not be over 13% of the entire 4420 Ha hence rating a ***Very low*** impact intensity. In spite the fact that 90% of the scheme land take will be in amalgamation with the current agricultural setup of the area and preparation of a Resettlement Action Plan has been undertaken, in case of scheme land take, issues such as; land acquisition of the damsite and command area.

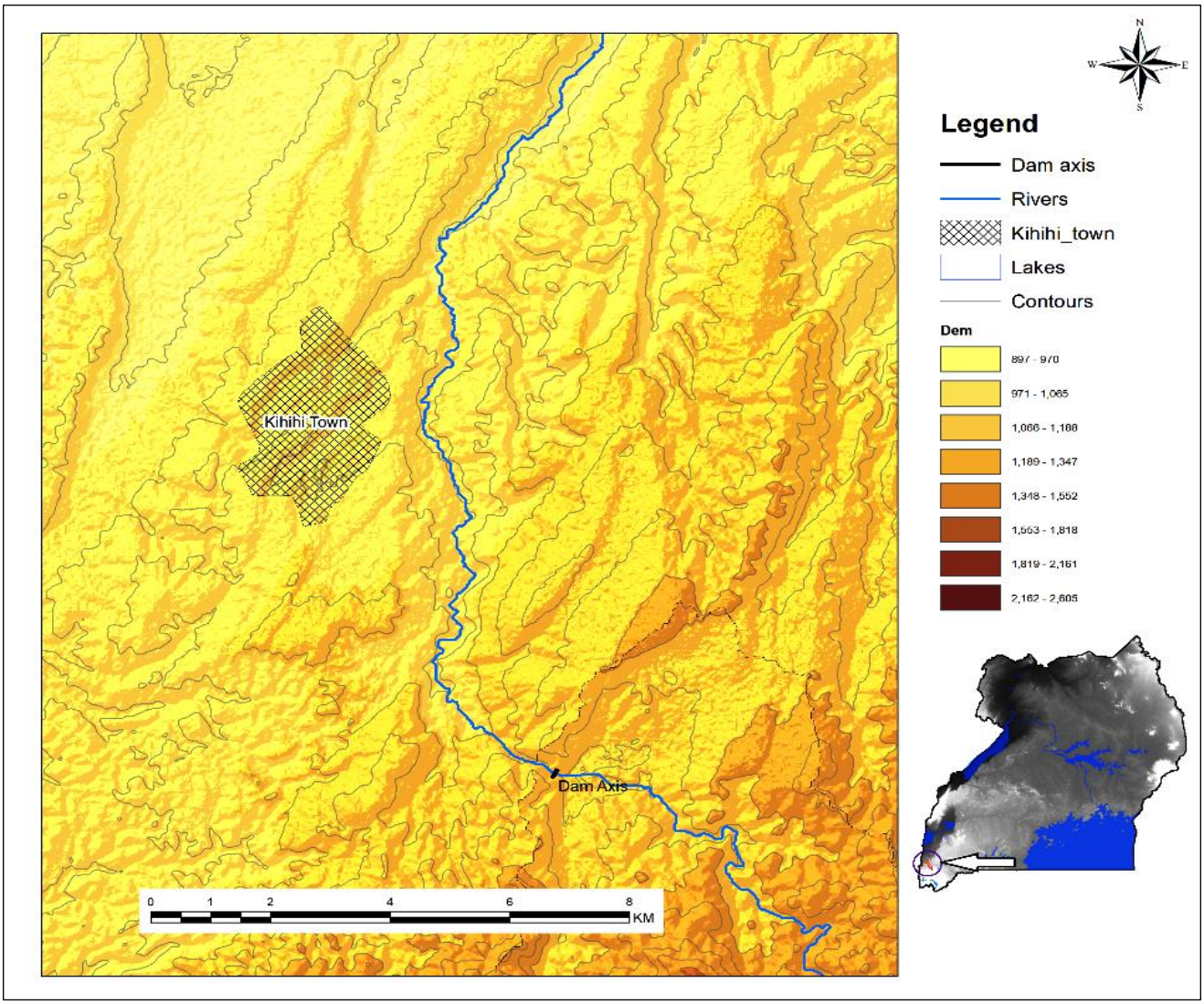


Figure 7-2 Proximity of downstream river valley to Kihihi Town.

Therefore, rating a ***High*** impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Major*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- Soils in areas covered by Vertisols have high water holding capacity and low infiltration rates therefore, irrigation water shall be applied slowly to avoid waterlogging**.**

- Use of broad beds especially on clayey soils (Vertisols) because these soils are prone to waterlogging especially during rainy seasons.
- MWE shall prepare and implement a Resettlement Action Plan (RAP) in which livelihood restoration for those negatively affected will be addressed.

Impact Mitigation Enhancement

✓ Review of the dam operational and management plan for flood risks.

✓ Contractor shall assess flooding hazards in terms of natural disaster events.

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Medium	High	Major 12
Residual Impact	Low	Low	Minor 4

7.2.13 Land Take

Land take in this context is the land required by the project at source site, for canal construction, and project axillary sites; offices, camps, equipment storage yards, stone quarries, access roads, borrow pits/areas, clay extraction during pre-construction.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√		

Impact Evaluation: Community owned land (Impact Receptors) will be affected due to project setup.

Impact Significance: Given that the project will involve construction of major hydrological infrastructure at the source (Water diversion weirs), closed pipeline network distribution stretching in the entire command area extent (9000 Ha) which covers (5) sub counties (district extent), the likelihood of occurrence of this impact is high and permanent. However aggregative estimate of land take for a command area of 4420 Ha is 13% while the land take for a command area of 9,000 Ha is 10%. The area for the dam, main pipeline remains the same for both command areas. Therefore the rating a ***Very low*** impact intensity. In spite the fact that 90% of the scheme land take will be in amalgamation with the current agricultural setup of the area and Resettlement Action Planning is underway, in case of scheme land take, issues such as;

- Land grievances and wrangles may arise.
- Land legal cases may be filed.
- Grievances arising due to delayed and faulted compensation.
- Land grabbing by community members may be triggered.
- Loss of livelihood mainly by the women (who have been practising agriculture on rented land).

- Mismanagement of compensation packages at household level.
- Increased encroachment on floodplain in search of cultivable land for crops.
- Loss of income due to destroyed crops, rental estates and business.

Therefore, rating is ***High*** for impact sensitivity. The product of both impact intensity and receptor sensitivity, rates a ***Minor*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- MWE shall prepare and implement a Resettlement Action Plan (RAP) for the scheme infrastructure and associated auxiliary sites based on Uganda's Land Access and Compensation Procedure and World Bank's Safeguard requirements (OP/BP 4.12), which require, amongst others:
  (i). Sensitization of community members whose property shall be affected.
  (ii). Completion of a full inventory of privately registered and/cultivated, grazed or other uses of the property that will be taken for the project as well as structures and graves within the scheme.
  (iii). Compensation to be paid in line with mandated rates agreed in consultation with the respective Project District Officials before commencement of construction activities.
  (iv). Ensuring that the Chief Government Valuer approves the valuation rates.
- Ensure stakeholder involvement and participation in all project stages.
- Ensure transparency in electing community committees e.g., project management committees through open nomination and/or voting mechanisms.
- Sensitize communities about environmental laws on wetlands, forests, land rights, etc.

Impact Mitigation Enhancement

✓ Adhering to both National legal framework, such as; Constitution of the Republic of Uganda, 1995; National Land Policy, 2013; National Irrigation Policy, 2017; National Agricultural Policy, 2013; Land Act, Cap 227, 1998; Local Governments Act Cap 243, 1997 and World Bank operational Safeguard requirements specifically OP 4.12 on Involuntary Resettlement.

✓ Continuous sensitization of the community about the project before commencement and engage local leaders in sensitizing PAPs.

✓ Ensure compliance to recommendations of the RAP report and implement livelihood restoration actions as proposed in the RAP report.

✓ Continuous engagement with all project stakeholders, especially the local administration leaders and the community for project ownership. This shall include continuous project progress feedback/reporting.

- ✓ Deployment of project Grievance Management Plan (GMP) as to capture and handle any land related grievances in relation to the project.
- ✓ Agreements with the landowners.
- ✓ Provide regular extension services such as training the various community and farmer groups on basic management approaches and resolution of conflicts/differences.
- ✓ District Environment Officer and NEMA to enforce the National Environment (Wetlands, Riverbanks, and Lakeshores) Management Regulations, 2000.

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Low	High	Moderate 8
Residual Impact	Low	Low	Minor 4

7.2.14 Impact on project area ecology

Project area ecology in this case refers to both the effected flora and fauna in the project area, both land and water.

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	√

Impact Evaluation: The project area biodiversity; Flora (section 5.2.1) and Fauna (section 5.2) (Impact Receptors) will be exposed to project activities under each phase. The district has many small rivers and streams like Ishasha, Nchwera, Kiruruma, Birara, Mitano and Lake Edward, which is the main source of fish besides fishponds. The district is also endowed with a number of wetlands, both seasonal and permanent, which serve as water reservoirs and other ecological functions. Anticipated project impacts on ecology include;

A. Impacts of Vegetation and Biodiversity Loss
B. Impacts on Birds, Mammals, Herpetofauna
C. Introduction of Invasive Species
D. Impacts on Fish

During pre-construction, construction and Dam filling

A. Impacts of Vegetation and Biodiversity Loss

Activities such as clearing the site (for construction of the dam, offices, campsite, irrigation channels and access roads) will require bush clearing, whereas excavated topsoil may also be heaped on vegetated environments. It's anticipated that during scheme construction, there will be an increase in road traffic associated with material and equipment haulage, these may crush vegetation causing disturbance of habitats

and will lead to loss of wooded grass lands and fauna. Removal of vegetation will increase degradation and the risk of soil erosion which at present is already a problem around the area. It will cause physical removal and disturbance of plants.

B. Impacts on Birds, Mammals, Amphibians, Reptiles, Butterflies

The construction phase will result into a number of habitat changes including;

- Vegetation clearance that will cause habitat loss as well as feeding and breeding grounds for birds and mammals.
- Compaction of the ground will destroy underground burrows for mammals which are rarely visible from the surface. Nesting and roosting grounds for birds will be destroyed.
- Flooding of land behind the dam will cause further loss of land cover and habitats for birds and mammals.
- Anticipated increase in traffic in the project area especially earthwork related may lead to intentional and unintentional killing or injuring of Herpetofauna.
- Increased exhaust emissions (carbon-dioxide, carbon-monoxide, nitrogen oxides, sulphur oxides, methane volatile organic compounds) and fugitive emissions (dust particles) from construction equipment and truck traffic may affect present fauna.
- Project workers' presence at site may also lead to indiscriminate killing due to negative attitudes towards Herpetofauna, especially snakes and lizards.
- Increased noise pollution from construction equipment and truck traffic may interrupt amphibian and reptile physiological activity. Amphibians and reptiles have been reported to suffer physiological and behavioral hearing loss and misinterpretation of environmental acoustical signals when exposed to noise (Brattstrom and Bondello 1983). According to Schwartz and Wells 1983 and Schwartz et al. 2001, noise often results in modification of calling behavior in males and may impair the ability of females to discriminate among call types and to discern location of calling males during breeding migrations. Petroleum products/hydrocarbons contamination.
- Fuel storage, vehicle and equipment operations may result in risk of spills. The spills may contaminate groundwater and surface water, which may affect breeding success of amphibians and other biodiversity. Mahaney (1994) found that petroleum contamination inhibited tadpole growth and prevented metamorphosis.

Hence this may cause Birds, Mammals, Amphibians, Reptiles, and Butterflies to migrate to safer grounds.

C. Introduction of Invasive Species

Already, at least five invasive species occur within the project area, i.e., red sage *(Lantana camara),* Golden wonder tree *(Senna spectabilis),* blackjack,*(Bidens Pilosa),* Goat weed *(Ageratum conyzoides)*, and Spear grass *(Imperata cylindrica)*. The introduction of exotic species of plant or animal may oust indigenous species or introduce disease agents, which may affect native plants, animals and/or man which result in biodiversity loss. Movement of uncleaned construction machinery and people can result in spread of invasive species. The invasive species may include pests and noxious weeds. Accumulation of sediments and high

concentration of nutrients in the water can lead to proliferation of aquatic weeds like water hyacinth, Pistia and water cabbage. These will reduce water quality and reduce water for irrigation. Water hyacinth in particular has wreaked havoc on Lake Victoria over the past three decades. This noxious weed spreads very fast, obliterates sun light from bottom waters, causes de-oxygenation and eutrophication and can kill fish. It blocks waterways and fish. The impact is likely to occur in the dam reservoir, along the riverine and irrigation command area.

D. Impacts on Fish

This ESIA baseline survey recovered clearly riverine fish species (*haplochromine cichlids*), potamodromous and migratory fishes due to the abundant prey organisms within the River Kiruruma water column. The construction phase of the project will have little negative impact on the fish stocks of River Kiruruma. However, there is great potential of contamination associated with the construction activities around weir construction at River Kiruruma, which include: sediments, fuels and lubricating oils, welding wastes; paints and solvents, which may cause the water to become muddy and full of detritus, soil and decomposing matter. Oxygen will also be depleted in the water, hence many of the small fish can be killed and some will escape to hide within the riverside vegetation. Other agents contain hydrocarbons and/or heavy metals such as lead, chromium and cadmium, which are known domestic water pollutants, could also affect the River Kiruruma's water quality. Any slight changes in water quality and quantity have differing impacts on the fish population within the river system. Breeding, spawning, though not demarcated, feeding, and the entire fish life require presence of substantial volumes of water. The riverine fisheries recorded are not fished and therefore do not sustain human populations within the areas recorded. Changes in volume and quality are foreseen during the irrigation scheme project and these will impact on the fisheries but to a minimal level. Creation of the dam area will favour species of larger and slow-moving water volumes mainly species of *Clarias* while impacting species with rapid water migratory tendencies as well as those that swim against currents. Dams are usually devoid of important species of *Cichlids* and these can only be stocked after adequate aquatic studies. Dredging during construction will have direct impact on water volumes within the dredged river section. The quality of water is also impacted through increased turbidity and potentially eutrophication. This further impacts aquafauna especially macroinvertebrates and the fish higher in the food chain. There is also further impact on other taxa such as herpetofauna especially amphibians through habitat loss.

E. Impact on protected areas:

The dam project steers clear of the Queen Elizabeth National Park but within proximity with its Ishasha Sector that is famous for the "Tree climbing lions". The sector is comprised of rivers; Ntungwe, Ncwera, Rwampunu and the main R. Ishasha, all of which have permanent water but with varying levels according to season. Although water reservoir components of the project are in close proximity to the greater ecotone of the park (Figure 7-3), the impact during especially construction is negligible given the entirety of the sector ecosystem. Various safeguards are in place, including;

- Ishasha sector is protected from elephant attacks by an existing trench constructed in the late 1990s and early 2000s. However, continuous maintenance of this trench shall be priority for the project to reduce vulnerability of both the project and the community.
- Beehives have also existed as measure of boundary prevention of errant elephants and therefore supporting the community to sustain this preventive measure is important as part of the Biodiversity Action Plan (BAP). The contractor shall be responsible for preparation and implementation of the Biodiversity Action Plan prior to commencement of construction. The BAP will include the following:
  - An overview of biodiversity in the affected area
  - Importance of biodiversity and ecosystem services
  - Legal and policy frameworks guiding the BAP (e.g., international agreements, national legislation)
  - Scope and purpose of the plan
  - Assessment of species, habitats, and ecosystems present in the region
  - Key species of concern (e.g., endangered, threatened, or endemic species)
  - Habitat types and their condition
  - Identification of the main threats (e.g., habitat loss, pollution, climate change, invasive species)
  - Specific goals related to species protection, habitat restoration, and sustainable use of natural resources
  - Measurable objectives for achieving the goals
  - Detailed plans for the conservation of priority species
  - Actions such as habitat protection, reintroduction programs, or captive breeding
  - Strategies for protecting and restoring key habitats
  - Measures such as habitat restoration, creation of protected areas, and sustainable land management
  - Initiatives addressing broader issues such as climate change, invasive species control, and pollution reduction
  - Roles and responsibilities of different stakeholders (government agencies, NGOs, local communities, private sector)
  - Mechanisms for collaboration and coordination
  - Budget for BAP
  - Capacity-building efforts
  - Phases of implementation with specific milestones and deadlines
  - Monitoring and Evaluation
  - Public Awareness and Education
  - Legislation review and Policy Recommendations
  - Annexures

Indirect impacts include:

- Irrigated agriculture outside QENP may fragment habitats, disrupting ecological corridors and migration routes
- Invasive species introduced outside QENP may spread into the national park, outcompeting native species and disrupting ecosystems.

- Pollution from surrounding areas, including air and water pollution, is likely to seep into QENP. This may affect habitats, wildlife, and affect ecological processes like nutrient cycling and food webs.
- Human activities near QENP, such as agriculture or settlements, can lead to conflicts between people and wildlife. This can result in retaliatory killings of wildlife or restrictions on species' movements.
- Water withdrawal will not impact the species at QENP due to availability of other streams and water sources in the area. In addition, the species have a wide range of habitats.

Mitigation Measures to Indirect Impacts on QENP:

- Adoption of integrated conservation strategies that consider the landscape beyond the boundaries of QENP.
- Engagement of local communities and adaptation to changing environmental conditions.
- Liaision with UWA in engaging local communities in conservation efforts is essential for success beyond QENP boundaries.

MWE in liaison with UWA will sensitize communities on legal frameworks that promote sustainable land use and protect ecosystem services beyond protected areas are essential for success.

The other existing forest reserves within the project area (Figure 7-3), although mostly gradually degraded, are contiguous with the sector as connected by the rivers and form areas of sound ecological integrity. The riverine inter-connections therefore form a very important part of their ecosystem connecting and sustaining populations that still persist especially of common primates such as vervets. However, these species are also highly adoptive and have gradually extended their home ranges outside these forests albeit as problem animals with their control left under the district vermin control office.

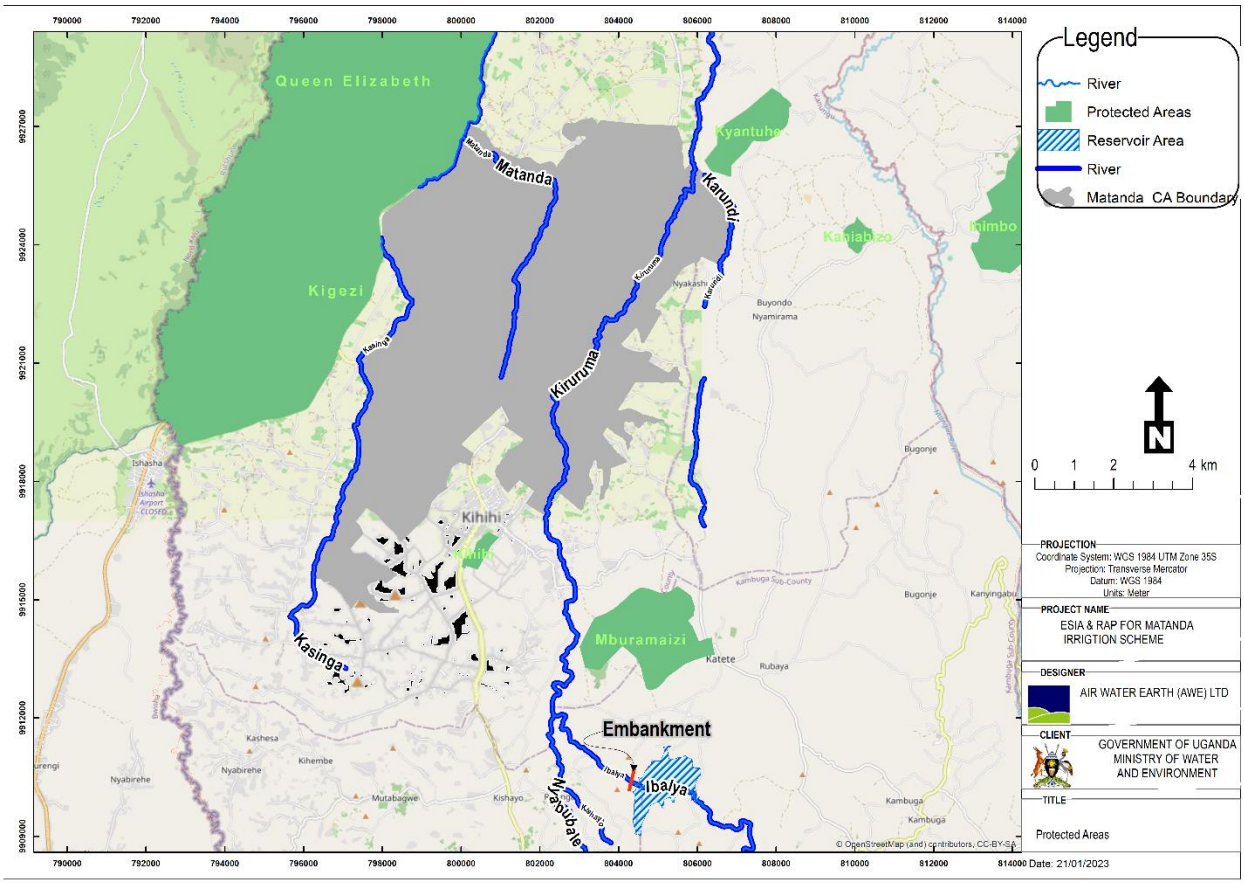


Figure 7-3 Location Map of surrounding protected areas near the project area

Wetlands are permanently inundated (under water) and the fluctuation of water levels determines the quality of wetland. To sustain their sizes and prevent further encroachment, the flow and volume of water need to continuously be sustained by enough dam flow. Their monitoring is also important throughout the project time to minimize their chances of being encroached by resident communities.

During operation, it is anticipated that scheme operational activities such as; clearing for cultivation, bush burning, application of pesticides, fertilizers in the command area will be the major contributors to vegetation loss. Applied chemicals bear a grate potential of contamination to project area receptors.

Habitat loss

As cultivation intensifies, there will be further vegetation clearance. The availability of water will encourage farming on large scale hence increased hectarage of most farmers, including remaining riverine vegetation clearance, hence reducing the habitat. Furthermore, for easy access most of the established facilities, access roads will be constructed, or the existing ones will be improved. If this option is upheld, there will be some disturbance of both the physical and biotic components of the environment in the project area. Habitat disturbance, fragmentation and eventual loss, due to vegetation clearance and excavations can impact fauna groups. The destruction will lead to loss of foraging, basking, roosting, patching, reproduction and hiding habitats for fauna. Modification of the natural landscape through deforestation, urbanisation and agricultural

encroachment, and the subsequent alteration of water bodies by erosion, eutrophication and siltation, is impacting on the ecological status of Odonata in Africa (Dijkstra *et al.,* 2011). The habitat/vegetation loss will slightly affect the home range quality of the fauna species but restricted to the project activity sites not the whole catchment.

Spread of invasive species of plant

Invasive plants have a large potential to suppress the native flora and change the structure and composition of the vegetation as they spread prolifically. From the surveyed area identified *Lantana camara,* and *Senna spectabilis,* are listed on global invasive species website as notorious alien invasive species in East Africa that require careful and prompt management. These were recorded mainly along the river, and they are very limited within the command area. They are known to suppress herbaceous plants and compete favorably with natural indigenous plants whenever there is a gradual or sharp change in climatic conditions, and as well as disturbances in the plant community. Other invasive species encountered within the project area listed mainly by agricultural departments include Blackjack (*Bidens Pilosa),* Goat weed (*Ageratum conyzoides)*, and Spear grass (*Imperata cylindrica)*.

Impact Significance: Increased vegetation and biodiversity loss, spillages, water, air, soil, and noise pollution, waste accumulation, and ecological loss, basing on the:

(i). Aggregative estimated 13% to be cleared arable land of the entire 9000 Ha command area,
(ii). Anticipated 200 fleet to be deployed characterised with numerous journey plans/ travelled routes and 30 construction fuel powered equipment's.
(iii). Anticipated types and quantities of fertilizers and pesticides approved under the Integrated Pest Management Plan (IPMP) to be applied during scheme operation.

Is anticipated that the likelihood of occurrence of this impact is short-term, localised in spatial extent during construction phase, whereas operational phase, it will be long-term covering a district extent, hence rating a ***High*** impact intensity.

One of the major concerns for abstraction of water from River Kiruruma is the downstream use of the water in the conservation areas of Queen Elizabeth National Park (QENP). Basing on the biodiversity assessment.

(i). Most species identified occur abundantly in a wide geographical range within the project area and have no significant conservation threats except for Mvule (*Milicia excelsa*) globally Near Threatened (NT), Brown mahogany (*Lovoa swynnertonii*) globally Vulnerable (Vu) and African linden (*Mitragtna stipulosa*) listed as globally Vulnerable (Vu). Five invasive species occur within the project area, i.e., *Lantana camara, Senna spectabilis, Bidens pilosa, Ageratum conyzoides, and Imperata cylindrica* although in small population spreads.
(ii). Mammals (such as; Common house rat, African pygmy mouse, and Giant rat); Birds (such as; Grey Crowned Crane, Red-Chested Sunbird, Yellow Wagtail); Amphibians (such as; Mascarene ridged Frog, Skink); Reptiles (such as; Blue headed tree agama and Olive grass snake) found in the command area as well as in the close vicinity of the river. The Grey Crowned Crane is globally Endangered. Beyond

these areas and in proximity with the Queen Elizabeth Park, threatened species such the African bush elephant (Endangered), Hippopotamus (Vulnerable) and Africn lion (Vulnerable) were recorded.

(iii). River Kiruruma is endowed with a variety of fish species that thrive throughout the different river sections, especially during the wet and high-water level seasons. All the species recorded are listed under the IUCN Red List of Threatened Species and National Red List for threatened species by WCS as Least Concern (LC) except for Labeobarbus sp. ranked as Vulnerable (Vu) which uses R. Kiruruma as a migratory route.

Both flora and fauna species had turned out to be resilient and adaptable to the prevailing ecological conditions associated with disturbances from human activity such as settlements and crop cultivation, hence receptor exposure to the impact will have a minimal effect rating ***Medium*** Impact sensitivity. The product of both impact intensity and receptor sensitivity rates as **Major** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

A. Impacts of Vegetation and Biodiversity Loss

(i) An eco-friendly design shall be used to promote a green environment around the facility.

(ii) Restriction of equipment to the project footprint and designated areas; movement of crews and equipment within the right of way and through routes provided for access to the work site, shall be performed in a manner to prevent damage to crops or property.

(iii) A restoration plan for the opened-up areas shall be drawn and followed to ensure re-establishment of the original vegetation or better conditions.

(iv) Identification and marking off areas with near natural/semi natural vegetation cover to be saved/managed as biodiversity areas.

(v) Clearing only vegetation that must be cleared for construction.

(vi) Ensuring that all the project activities are carried out within the boundary of the site to avoid damage to surrounding vegetation.

(vii) Sensitization of the communities and local authorities about the importance of trees/vegetation cover.

(viii) Sensitization of all the construction and other workers of the need to minimize vegetation destruction and their role in conservation of flora and fauna.

(ix) Minimize tree cutting and ensure that it's restricted to the delineated areas. During vegetation clearance, spare mature indigenous trees whenever possible.

(x) All farmers shall be sensitized to increase their awareness about the need to minimize environmental damage while carry out vegetation clearance during cultivation in the irrigable area and limit vegetation clearance to portions of the land to be affected. This is to allow fauna to migrate to adjoining bushes during the operations.

B. Impacts on Birds, Mammals, Herpetofauna

(i) Adoption of environmental flow of 0.64 m^3/s for low flow regimes and a one in two-year flood of 13 m^3/s of R. Kiruruma

(ii) Select low emission equipment as much as practicable to minimize exhaust emissions and fugitive emissions.

(iii) Shut down equipment when not in use to minimize idle time noise generation.

(iv) Reduced or no use of pesticides/fertilizers through manual weed removal and supporting biocontrol agents such as birds and other pest predators.

(v) Ensuring that all the project activities are carried out within the boundary of the site to avoid destroying herpetofauna, birds and mammals or their habitat.

(vi) Sensitization of the communities and local authorities about the importance of herpetofauna, birds and mammals.

(vii) Only qualified personnel shall handle wildlife or fauna in case translocation is necessary.

(viii) Maintaining speed limits as defined in the Land Transportation Procedure under project Traffic Management Plan.

(ix) Installation of an electric fence along the park and project area by the Uganda Wildlife Authority (UWA) under the World Bank-funded Investing in Forests and Protected Areas for Climate Smart Development-(IFPA-CD) Project P170466 is over 80% complete. An independent ESIA was prepared and approved by the National Environment Management Authority (NEMA).shall.

C. Introduction of Invasive Species

(i) Undertaking pre-inspection and cleaning of all construction equipment prior to shifting to another site.

(ii) Undertake pre-inspection of each construction site.

(iii) Restricting equipment and vehicles to the project footprint and designated areas.

(iv) Come up with an avoidance plan of invasive species to the near natural or semi natural habitats to serve as biodiversity areas.

(v) Restore disturbed areas immediately after operations to allow natural regeneration take place to close the disturbed areas with natural vegetation.

(vi) Monitor growth of invasive species of plants.

(vii) Sensitize communities about the need to control the spread of water hyacinth and encourage them to physically remove and destroy water hyacinth found floating on the river and other water courses.

(viii) Sensitize workers and communities about the dangers and threats the invasive species pose to ecosystem stability so they minimize moving them into or out of the project area.

(ix) Effect the multiplication of weevils for the control of water hyacinth.

D. Impacts on Fish

(i) Adoption of environmental flow of 0.64 m^3/s for low flow regimes and a one in two-year flood of 13 m^3/s of R. Kiruruma.
(ii) Develop catchment management plans for R. Kiruruma and other rivers affected by the project.
(iii) Save natural vegetation cover within a 30-meter band along the river, to conserve fish habitats. This is best done by enforcing the NEMA Riverbanks and Lake Shore Regulation.

E. Impact on protected areas

(i) The flow and volume of water needs to continuously be sustained by enough dam flow, through monitoring throughout the project.
(ii) Biodiversity Action Plan (BAP) shall be developed.

Impact Mitigation Enhancement

✓ Adhering to both National legal framework and World Bank operational safeguard requirements, specifically OP 4.04 on Natural Habitats.
✓ Deployment of decommissioning plan and restoration plans for all sites to alleviate biodiversity loss.
✓ The refilling plan shall include occasional drawdown of reservoir water levels to get rid of the aquatic weeds.
✓ Closely monitor and supervise the irrigation operations to ensure compliance with the EFR. This role shall begin with the project staff but will also require regular checking by the relevant officers responsible for compliance of development projects to the approval terms and conditions.
✓ Key or major breeding areas will be mapped and considered as "ecological significant areas" and where appropriate provide with special protection measures to allow continued breeding of the target species. The special protection measures will include water flow adjustments, use of bypasses in case of increased flow, or provision of high flows to maintain fast currents for those species that prefer fast flowing water during the breeding season.

Residual Impact*:* Adoption of the above measures will reduce the impact to ***Moderate*** significance

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	High	Medium	Major 12
Residual Impact	Low	Medium	Moderate 6

7.2.15 Destruction of physical cultural resources (PCRs) and archaeological heritage

Baseline studies established presence of physical cultural and archaeological resource in the project site, including;

- Banyabitumbi community tree looked after by the Banyabitumbi community association, located in Kihihi town council, Rwanga ward [UTM 35N 0799140, 9917050] - Command Area extent.
- Graves in the project area.
- Pot shards of modern age period-Command Area.

- Batwa, VMGs' in the project area (Kengoma village, Kihembe Parish, Kanyantorogo Subcounty).

Project phase impacted	Pre-Construction	Construction	Operation (Post Construction)
	√	√	

Impact Evaluation: The Banyabitumbi community and family members with affected graves (Impact Receptors) will be exposed to scheme pre-construction and construction phase.

Impact Significance: Given that the project will involve construction of closed pipeline network distribution stretching in the entire command area extent (9000 Ha) which covers (5) sub counties (district extent), the likelihood of occurrence of this impact is low but permanent. Community consultations revealed that households in the project area possessed graves for family members. The graves range from modern cemented graves to the ordinary stone covered mud mounds. The population is attached to their graves and queries were made about the effect on the graves by the project during trenching in Section 5.6.16. The cited Banyabitumbi community tree located in the command area, is not impacted by the proposed project hydrological infrastructure hence rating a ***Very low*** impact intensity. However, this impact is only anticipated because of accidental unearthing of archaeological remains (chance finds) especially during excavations that may lead to their loss or permanent displacement due to land disturbances during trenching (Unplanned impact).

Receptor exposure effect will decrease with offset distance from proposed project hydrological infrastructure, hence rating a ***Low impact*** sensitivity, given that:

- Identified potsherds were of modern age period from the pottery locally made and the population do not find any importance in broken pottery pieces and were amused by queries on these materials.
- Resettlement Action Planning underway if there are any identified affected graves.
- No physical impact on Banyabitumbi community tree. However, conflict with community over disrespect to cultural heritage in the project area may arise if workers are not oriented on appropriate behavior during activities (Unplanned impact). Therefore orientation/induction of project personnel on appropriate behavior around this cultural site will be required.
- The camp for the Batwa in Kanyantorogo Subcounty is within the command area and a number of agencies are partnering with the Government of Uganda to extend services to the camp, including construction of houses and extension of water. A number of projects have been extended to this area to better their lives.

The product of both impact intensity and receptor sensitivity, rates a ***Minor*** overall impact significance.

			Sensitivity of receptor			
			Very low 1	Low 2	Medium 3	High 4
Intensity of impact	Very low	1	Negligible 1	Minor 2	Minor 3	Minor 4
	Low	2	Minor 2	Minor 4	Moderate 6	Moderate 8
	Medium	3	Minor 3	Moderate 6	Moderate 9	Major 12
	High	4	Minor 4	Moderate 8	Major 12	Major 16

Mitigation Measures

- Conducting a Resettlement Action Planning for the scheme, developed based on Uganda's Land Access, Compensation Procedure and World Bank's Safeguard requirements (OP/BP 4.12) and OP 4.11 on Physical Cultural Resources (PCRs).
- The project shall avoid affecting any known PCR, and a Chance Finds Procedure has been provided in the ESIA to guide handling and management of chance finds.
- A preconstruction survey of the RoW shall be undertaken to collect data on location, extent, and mitigation measures of known and unknown assets (tangible and intangible cultural heritage, TCH and ICH), espacilly graves identified under RAP and to consult community leaders about practices not yet identified.
- A schedule of sites and actions to be undertaken will be prepared and included in the cultural heritage management plan (CHMP).
- A senior cultural heritage monitor (SCHM) will ensure that the Cultural Heritage Management Plan (CHMP) will be implemented, in agreement with relevant government authorities, in advance of construction. The CHMP will include a chance finds procedure.
- The SCHM will prepare the chance finds procedure (CFP); Chance finds will be excavated by suitably qualified and approved archaeologists, in accordance with the CFP and authorised by the relevant government authority.
- Information on intangible cultural heritage (ICH) collected during the preconstruction survey will be evaluated and integrated into the Cultural Heritage Management Plan (CHMP). This will include information on Batwa.
- A CHMP will include details of all cultural heritage features identified before and during construction. The CHMP will inform cultural heritage management measures that may be required during project operation.
- Workers shall be sensitized to be aware of the possibility of encountering archaeological remains and the chance finds procedure to be followed.
- Regular trainings shall be conducted to ensure the workers manage the PCRs as per set regulations and guidelines under OP 4.10.
- Implementation of safeguards presented under Vulnerable and Marginalised Groups' Framework/VMGF for Matanda irrigation schemes (Appendix F). MWE will further prepare a VGMP and implement support programs targeting the Batwa.
- MWE will continuously consult and ensure participation of the VGMs during project implementation.
- MWE will operationalize a grievance management system that will allow VGMs to register, their concerns during project implementation and get them investigated and closed through provision of timely feedback.

Impact Mitigation Enhancement

- ✓ Continuous sensitization of local community, the community and its leaders, about archaeological findings before site clearance.
- ✓ Report any unforeseen discovery of cultural significance during construction works to the Department of Museums and Monuments.
- ✓ Development and implementation of Vulnerable and Marginalised Groups' Plan(VMGP) for Matanda irrigation scheme targeting the Batwa (outlined in Appendix F).

Residual Impact: Adoption of the above measures will reduce the impact to ***Minor*** significance.

Impact evaluation	Intensity	Sensitivity	Significance
Before mitigation	Very Low	Low	Minor 2
Residual Impact	Very Low	Very Low	Minor 2

7.2.16 Dam and reservoir construction and operation and management Impacts

The construction and filling of dam for irrigation development has significant impacts on the environment and communities. Here are some of the key effects:

Impact on Livelihood:

- Resettlement: The construction of Matanda Dam will require the relocation of communities living in the dam and reservoir areas that will be flooded. This displacement will lead to loss of agricultural land and social networks, affecting livelihoods.

Impact on waste management

- Organic waste such as plant debris and agricultural runoff can accumulate in the reservoir, leading to eutrophication, where nutrient levels increase and cause harmful algal blooms. This can negatively impact water quality.
- Construction of the dam and filling of its reservoir can lead to increased human activity leading to increased waste generation. Without adequate waste management systems in place, this can result in environmental degradation.

Water Abstraction and Dredging

Water Abstraction:

- The construction of Matanda Dam and filling of the resevoir is to provide water for irrigation and this may change water quality and quantity downstream.

Mitigation:

- MWE will secure a water abstraction permit for Matanda dam and ensure compliance with the conditions therein.
- MWE shall provide extension services to the farmers which will lead efficient use of water for irrigation and therefore high water productivity.

Dredging:

- Construction of matanda dam will require dredging of the river bed for foundation treatment and temporary river diversion.This is likely to affect the water quality and quantity for down stream users.

Mitigation:

- MWE shall ensure that the contractor prepares a work methodology that minimises effects on water quality to downstream users.

Use of pesticides

- The construction of Matanda dam will enable the expansion of agricultural areas by providing a reliable water source for irrigation. This will lead to more intensive farming practices, which may require increased pesticide use to protect crops from pests.
- Reliable irrigation water supply will allow for multiple cropping cycles per year, which could lead to more frequent pesticide applications as more crops are grown and thus exposed to pests.

Mitigation:

- The project will prepare and implement an Integrated Pest Management Plan (IPMP)**.**
- The project will provide agricultural extension services to farmers in effective use of pesticides.

Security management

- The construction of matanda dam will comprise installation of other components like steel-controlled gates, pipes, accessories and sanitation facilities which might attract theft and vandalism by community members.

Mitigation: The project will prepare and implement a security management plan.

7.3 Cumulative impacts

Defination: *"The U.S. Council on Environmental Quality (1997) defines cumulative impacts as the impact on the environment which results from the incremental impact of the action when added to their past, present and reasonably foreseeable future actions regardless of who undertakes such an action. These impacts can be individually limited but cumulatively considerable, or for which the incremental effects of individual projects are considerable. In practice, assessment of cumulative impacts requires consideration of other assessment concepts, which are different from the conventional approaches used in a normal ESIA".*

Under this section, the cumulative impact assessment is based on IFC Good Practice Handbook on Cumulative Impact Assessment and Management (IFC, 2019). The concern for assessment of cumulative impacts is driven by the need to understand the conditions of Valued Environmental and Social Components (VECs) that are expected to result from the combination of development impacts and natural forces. Chapter 5 above presents the baseline conditions that have been benchmarked to come up with Thresholds (limits of acceptable change). According to IFC, if such thresholds are not established, the significance of cumulative impacts cannot be determined.

The cumulative impact assessment of environment and social parameters cover the project area and its influence zone (section 4.4). It focused assessing impacts in relation to the following aspects.

- Beneficiaries and the project owners' activities and facilities that are a component of the project.
- Potential impacts from unplanned, but predictable developments caused by the project that may occur later or at a different location.
- Indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.
- Associated facilities which are not part of the project but without which the project may not be viable; and
- Incremental impacts, on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined developments at the time the risks and impacts identification process is conducted.

These impacts maybe individually limited but cumulatively considerable or for which the incremental effects of an individual project are considerable when viewed in connection with past projects, current projects and probable future projects. Table 7-3 shows past, ongoing and planned projects for implementation within the command area.

Table 7-3 Assessed projects in the command area extent.

Category	Project	Status at the time of the study	Coverage in the command area extent	VEC	Cumulative impacts
Road infrastructure	The 79 km Rukungiri – Ishasha – Kanungu Road was commissioned in 2023.	Ongoing	Road traverses Nyamirama, Kanyantorogo sub counties and Kihihi Town council. Some of the auxiliary facilities are located within the command area; the camp is located in Kihihi Subcounty while borrow pits are in Kanyantorogo and Kihihi Town council.	Crossing streams which drain in the catchment of R. Kiruruma, R. Kasinga and R. Karundi, which in turn drain the middle, upper and lower sections of command area respectively. Community in the command area	▪ Increased traffic impacts; delays and accidents. ▪ Improved access to social services.
	Cumulatively, from 2018 to date, over 310 Km of Kanungu District feeder roads have been maintained, 6.6 Km of District roads rehabilitated, 21 Km of District Road opened, and Munyaga Bridge constructed. Periodic maintenance of these roads is expected to continue in the future. Additionally, all these road related projects require; extraction of material (aggregates, murram, and water), land take (for right of way, camp site), which cumulatively affects the community.	Past and future	Kanungu District		▪ Increased sourcing of materials (aggregates, water, murram). ▪ Increased traffic impacts; delays and accidents. ▪ Improved access to social services.
Agricultural Infrastructure	Construction of roadside market / crop marketing facility at; i) Bugongi trading centre, Kambuga Subcounty fruits / vegetables sold in hygienic environment ii) Kyeijanga / Kirima Subcounty	Past	Kirima Subcounty, Kambuga Subcounty and Butogota TC	Social conditions such as community access to agricultural products and better yields.	▪ Increased agricultural market. ▪ Increased agricultural income to the riparian communities.

Category	Project	Status at the time of the study	Coverage in the command area extent	VEC	Cumulative impacts
	iii) Kambuga / Kambuga Subcounty Butogota TC These trading centres lie in the centre of potential agricultural production zone and rich agricultural hinterland. A combination of their location on the main road and rich hinterland makes the area a suitable area for development of roadside markets. These were all planned for 1-year construction period by Kananugu district.				▪ Improved access to agricultural services.
Irrigation Infrastructure	10 acre solar-powered Kameme demonstration irrigation scheme developed by the office of President of Uganda on River Ntungwa formed downstream of the confluence of River Mitano and River Kiruruma. Kameme mini-irrigation scheme weir abstraction of water from River Ntungwa (804848E, 9932343S).	Operational	Kameme village, Kibimbiri Parish, Kihihi Subcounty	Ecosystem services, water and nutrient cycles in Matanda command area and R. Kiruruma.	▪ Increased water abstraction from River Kiruruma downstream.
	Ongoing construction of Nyarurambi small scale irrigation scheme, abstracting from River Rushaya. It is anticipated that a series of such agricultural developments trigger cumulatively impact on land use patterns, having cumulative impacts on downstream water availability (from withdrawal of water for irrigation), on downstream water quality, or on local community livelihoods.	Ongoing	Nyarurambi village, Rushoroza Parish, Kihihi Subcounty		▪ Increased usage of pestcides.
Relocation	Batwa, are the original inhabitants in the Great Lakes region and are formerly renowned as forest-dwelling hunter-gatherers who became squatters living on the edges of society on establishment of the Bwindi and Mgahinga National Parks in 1991. The Batwa did not only become landless with extreme poverty, reduced	Past	Kengoma village, Kihembe Parish, Kanyantorogo Subcounty	Cultural aspects. There are two camps located in Kengoma and Kanyashande cells, Kanyantorogo	▪ Creation of employment opportunity for the VMGs' in the project area. ▪ Expose the VMGs' to modernized methods of farming.

Category	Project	Status at the time of the study	Coverage in the command area extent	VEC	Cumulative impacts
	to a life of destitution, living on non-Batwa's land as squatters with no cultural place (forest) to offer religious sacrifices to their gods but were also forced to resort to begging, providing cheap manual labor and prostitution for survival. Unfortunately, they were neither involved nor considered for consultation and compensation when the decision-making process to exclude them from the forest was being taken. The camp in Kanyantorogo Subcounty is within the command area and a number of agencies are partnering with the Government of Uganda to extend services to the camp, including construction of houses and extension of water. It is anticipated that to better their lives, a number of projects may be extended to this area. Through technical assistance for institutional strengthening of MWE and MAAIF, these in turn will enable transcending of capacity building to the VMFGs. This will ascertain proper management of the proposed project which in turn implies that VMGs will actively participate and have a fair share of the project benefits as a result of increased number of VMFGs.	Ongoing Project Implimentation		subcounty in which the Batwa (vulnerable and marginalized group, internally displaced persons or environmental refugees) are currently settling, south of Matanda Irrigation Scheme command.	• Improved VMGs' attitude towards agriculture. • Encourage establishment and strengthening of vulnerable and marginalised farmers groups (VMFG) that will contribute to social cause of the groups. • Access to good agricultural practices, sustainable land management practices, integrated pests and disease management knowledge through trainings. • VMGs whose land is found suitable for the infrastructure may lose land or crop cover or both.
Human - Wildlife Conflict	Fencing of Ishasha Sector, Queen Elizabeth National Park (QENP). According to UWA (2022), there is increasing prevalence of Human Wildlife Conflict (HWC) at the boundaries of Queen Elizabeth National Park (QENP), with local farmers experiencing severe crop losses especially at the sectors that are not	Studies ongoing. A Project Brief for the proposed fence has been	Upon plotting the coordinates shared by the IFPA-CD-P170466 Safeguards Team on the Matanda command area under the ICRP project, it	Matanda command area communities living close to the protected areas.	• The fencing of QENP is a likely positive cumulative impact to the ICRP because the fence will deter animals from crossing into irrigated farms hence

Category	Project	Status at the time of the study	Coverage in the command area extent	VEC	Cumulative impacts
	covered by the electric fence. This is being exacerbated by the fertility of the national park boundaries that attract both subsistence and commercial farming activities. The most common animal species affecting communities is elephants. To address this endemic issue of Human Wildlife Conflict (HWC) among communities living close to the protected areas, UWA plans to utilize part of the funds from World Bank under the Investing in Forests and Protected Areas for Climate-smart Development project (IFAP-CD) to construct additional 61 kms of the fence to further minimize HWC in these areas. The areas that will be fenced include Nyamugasani-Isingo (18km), KCCL-Karusandara (21km), Ishasha-Bwentale (9km) and Kagarama-Mahyoro (13km). To ensure its effectiveness, a linear fence with 3 lines of live wire will be erected with powering points at every 5km in the proposed project areas within Kasese, Rubirizi, Kamwenge, Rukungiri, Kanungu, Ibanda and Mitooma districts.	prepared and submitted to World Bank for review. Procurement of the fence material supplier is at contract signature stage.	was observed that the command area will be adequately covered by the existing and planned electric fence as shown in Figure 7-5. However, as of January 2025, the construction of an electric fence along the park and project area by the Uganda Wildlife Authority (UWA) under the World Bank-funded Investing in Forests and Protected Areas for Climate Smart Development-(IFPA-CD) Project-P170466 was over 80% complete		deescalating HWCs. On the other hand, the ICRP irrigation interventions will also bear cumulative positive impacts to the conservation of QENP by improving farm productivity and enhancing agribusiness income to farming communities thereby reducing poaching.

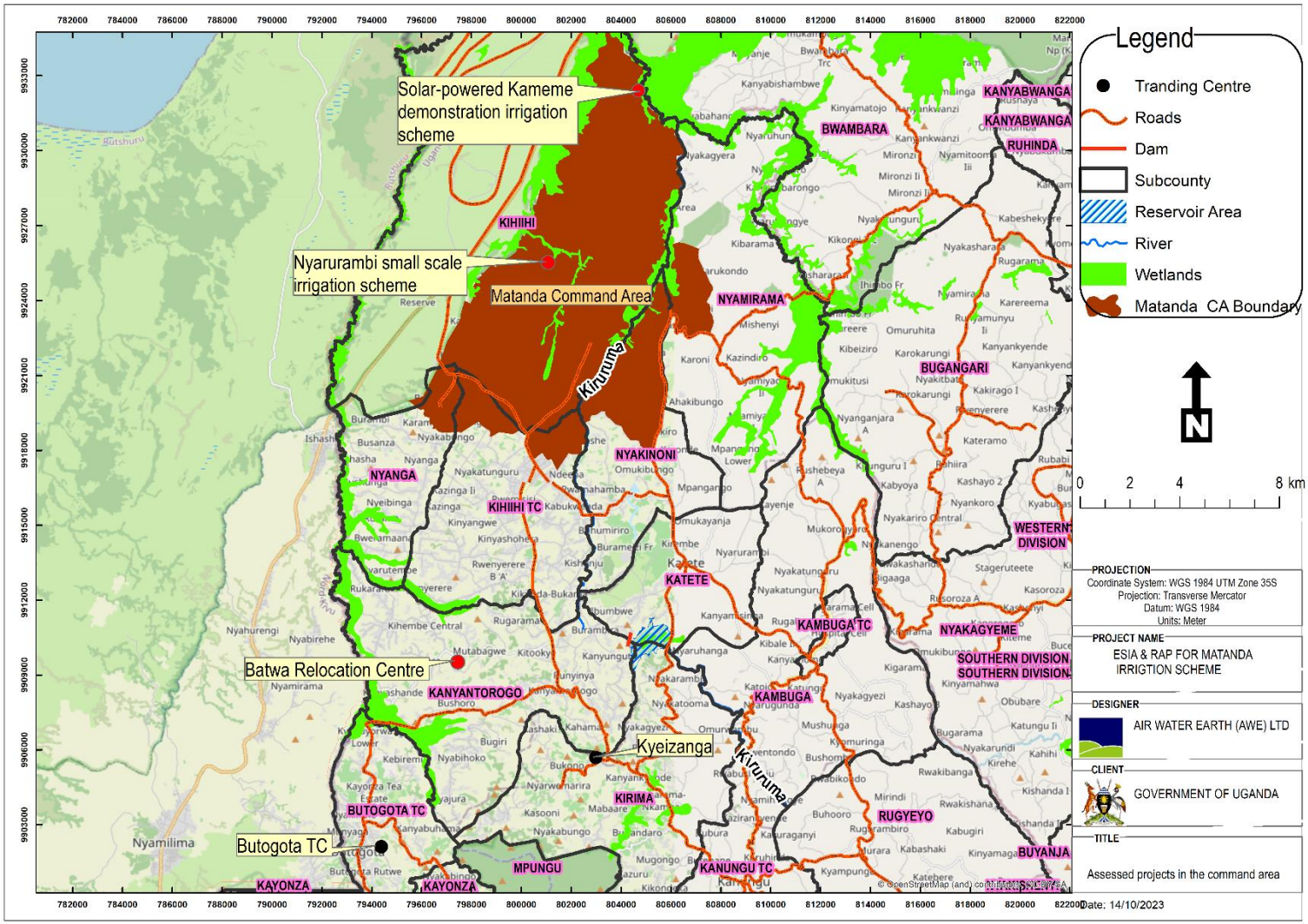


Figure 7-4 Location map for identified projects relationship with proposed Matanda irrigation command area

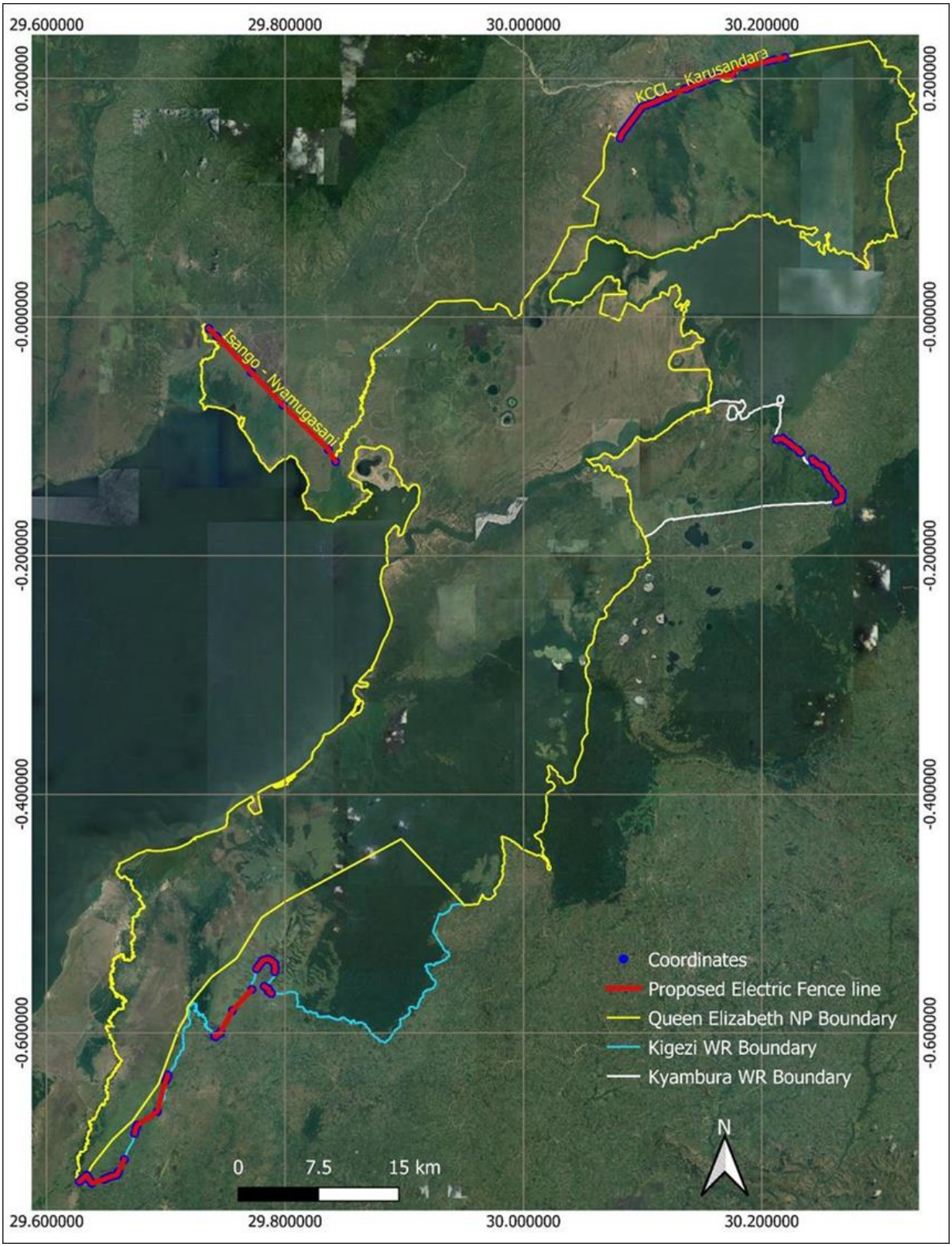


Figure 7-5: Map of QENP showing the proposed fence sites (Source: UWA, 2022)

Positive Cumulative Impacts:

Implementation of the Matanda irrigation scheme, in addition to the projects presented above will cumulatively lead to the following, positive impacts:

(a) **Improved access to social services**: There will be improved accessibility, trade and commercial opportunities after the planned rehabilitation of community access roads which will enhance commercial opportunities as well as delivery of social services in the beneficiary areas.

(b) **Development in the area**: Improved road network coupled with increased agricultural productivity will lead to development in the area. This is because farmers will have easy access to markets and agricultural inputs. Additionally, this will influence investments into other sectors such as health, tourism, and education, which will overall spur development in the area.

(c) **Increased agricultural income to the riparian communities:** Implementation of the irrigation scheme project will increase agricultural productivity. The improved road network created by the ongoing road construction and maintenance projects will increase farmers' accessibility to markets, both locally and nationally. This will in turn increase income earned from agricultural activities and overall improve farmer's livelihoods.

(d) **Increased skills and knowledge transfer:** Simultaneous implementation of Matanda irrigation scheme and the aforementioned projects will lead to knowledge and skills transfer to the locals, especially the youth that will have been employed on the projects. These artisan skills can be applied locally to boost livelihoods of the communities or will enable these skilled persons to get employment opportunities in other areas on other projects.

(e) **Gender empowerment**: Aware of eminent gender disparities in the project areas, the project has measures aimed at empowering the women who are participating in the project through training and skilling on income generation, record keeping and savings which will be some stride towards women empowerment.

Impact Enhancement to Cumulative Impacts

i. Local government shall monitor all ongoing projects as per district plan.
ii. Local government shall establish mechanisms for rallying communities to protect the project infrastructure.
iii. Planning and currying out periodic maintenance works.
iv. Local government shall collaborate with all development partners (private, NGOs, donors, and government) in the command area.

Negative Cumulative Impacts:

Multiple and successive negative environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed Matanda irrigation scheme and/or anticipated future developments in Kanungu District, may result in significant cumulative impacts, such as:

(a) **Increased exposure to noise**: The noise currently generated by the ongoing construction activities is high especially from Rukungiri – Ishasha – Kanungu Road construction project. This will cumulatively increase with simultaneous construction proposed project. Activities such as movement of construction vehicles and machinery including trucks, concrete mixer, earth works, offloading and loading of equipment and material at site among others will generally contribute to the increase in noise levels. These may have such effects; irritability, anxiety, mental fatigue, interference with sleep and/or recreation, and personal communication, and physical damage to the eardrum, blood pressure and pulse rates due to excessive noise exposure.

(b) **Influx of people**: All the aforementioned projects will require labour, some of which may be sourced locally, but also considerable numbers will be sourced outside the district. Additionally, the operational phases of these projects, especially irrigation schemes, will attract people from various parts of the country to engage in agricultural activities in the area and overall, this will increase population in the area. Increased number of people in the area will in turn increase pressure on already burdened resources such as health facilities and water resources. Additionally, since these people will originate from different cultural backgrounds, their influx may cause cultural dilution and increase risks of social ills such as theft, rape, and defilement.

(c) **Increased air pollution**: The impact of rehabilitation works on air quality discussed under Section 7.2.3 will be intensified by air pollution from the other aforementioned projects. Simultaneous sourcing and haulage of construction materials required by all these projects and operation of vast numbers of equipment will increase total suspended particles (dust particles) of more than 300 µgN m^{-3} and trigger ppm or µgN m^{-3} of toxic gases above the draft NEMA's air quality standards. These may have such effects as allergies, irritation of the eyes, coughing, sneezing, asthma attacks, form dust layers coating on property and vegetation, furniture.

(d) **Depletion of material sources**: All the aforementioned projects require materials especially gravel. Feasibility studies conducted already indicate limited availability of especially borrow pits in the project area. With increased demand of these material, there is a likelihood of depletion and unstainable use of this resource. It is therefore recommended that the project utilizes already existing borrow pits and only open up new ones when inevitable. This will also reduce the footprint that would otherwise be created by opening up too many borrow pits in the project area.

(e) **Increase in impervious surfaces**: Increased infrastructure development will lead to increased impervious surface area, hence more storm water runoff during construction and operation causing

stream channel erosion, wetland degradation, fragmentation, and loss, altered area hydrology, sediment transport and pollutant loading, litter and refuse. Elevated water temperatures caused due to runoff from impervious surfaces that have been heated by the sun. Higher temperatures can stress aquatic life and raise water quality issues.

(f) **Wetland degradation**: From the entire Matanda command area, mainly Kanyantorogo, Kirima, and Kihihi sub counties and Kanungu Town Council have been affected by wetland degradation, attributed by poor drainages to create farmland, over harvesting of resources from the wetlands, prolonged drought that reduces soil water retention and population pressure on existing wetlands. This has reduced capacity of wetlands to purify water, degraded riverbank/flood plain wetlands, in turn increasing siltation of River Kiruruma and streams evidenced by flow and water turbidity. Due to the many ongoing construction projects coupled with this project; aggregative construction activities may expose the water bodies to; toxicity to aquatic life with toxicants such as heavy metals from which adverse impacts may result from chronic exposure and bioaccumulation of pollutants. Sediment contamination where bottom substrates in the aquatic environment accumulate contaminated sediment that could interfere with the reproduction and feeding mechanisms of aquatic organisms, such as fish. Impaired aesthetics due to turbid water, trash, debris, and an oily sheen that may reduce the visual appeal of waterways and affect recreational potential.

(g) **Reduction of water flow in a watershed** due to multiple withdrawals from the cited irrigation schemes and developments. This may increase demand of water for social needs and the ecological requirements that depend on the River Kiruruma and other rivers/streams in the command area. This situation may lead to challenges to long term recharge of the dam from its catchment. However, the areas upstream of the dam are sparsely populated and impacts on recharge impact is unlikely to be significant. It may also cause moderation effect on the base flow downstream over the seasons. This will include release of lower flows during wet seasons and release of higher flows (as environmental flows) during dry seasons. Additionally, reduction of water flow may also affect the capacity of the handling the pollutants discharging from agricultural, settlements and urban areas including agro-chemicals, organic matter, and urban pollutants through dilution.

(h) **Increased road accidents**: These may result from speediness of road transport vessels as a result of better road conditions after construction, especially on the road leading to the Dam site. Simultaneous implementation of the aforementioned projects will increase traffic in the command area due to transportation of workers and construction materials and even during the opration phases. This will increase risks to accidents in the area.

PROJECT ALTERNATIVES

8 PROJECT ALTERNATIVES

This section provides an overview of the location and design alternatives that have been considered as part of project planning. The current description of the project as provided above (Chapter 2) is the result of examining various alternatives, with the goal of developing a project that is both technically and financially feasible, and which minimizes negative environmental and social impacts to as low as reasonably practicable and promotes positive ones. The following project alternatives were identified.

- ✓ Scheme location alternatives
- ✓ Design scenarios
- ✓ Irrigation method options
- ✓ No project option
- ✓ Project action option

8.1 Scheme location alternatives

Matanda irrigation scheme is mainly comprised of two attributes, including; the water abstraction site (Dam location and Reservoir) and would-be irrigated area (command area location).

8.1.1 Scheme dam location alternatives

There are many factors that are considered when selecting a dam site. This section deals with only hydrology factors. A good reservoir site is one that maximizes storage and minimizes losses for the lowest cost. Therefore, the target is to select a site where the following characteristics can be met:

- Runoff – site shall be one that has sufficient runoff to meet water demands for the project and also allows for sufficient allowances of environmental flows.
- Site that maximizes the useful life of the reservoir – in general this is the site that maximises the impounded water volume (allowing for sediment storage and accumulation) for a given dam height.
- Narrow section of river to minimize the length of the dam axis.
- Geological factors – the site shall be one that results in less percolation.
- Evaporation factors – site shall be one that results in less losses through evaporation, i.e., lower surface area.

The key comparison parameters for the three sites are shown in Table 8-1. Figure 8-1 shows the locations of the 3 sites and their catchment.

Table 8-1 Key data for site comparison

Parameter	Lower site	Middle site	Upper site
Catchment area (km^2)	170.8	154.5	137.9
Mean discharge at the dam site (m^3/s)	2.3	2.1	1.8
Catchment slope	24.8	26.2	27.4
Stream length	42.5	38.6	34.7
Minimum elevation (m) at dam site	1086	1122	1248
Storage volume at 10 m height (Million m^3)	0.68	0.16	1.07
Storage volume at 20 m height (Million m^3)	4.21	1.39	14.80
Storage volume at 30 m height (Million m^3)	12.07	4.47	39.51
Dam axis length at 10 m height (m)	245	78	57
Dam axis length at 20 m height (m)	320	175	108
Dam axis length at 30 m height (m)	451	262	169
Channel length (Km)	42.5	38.6	34.7

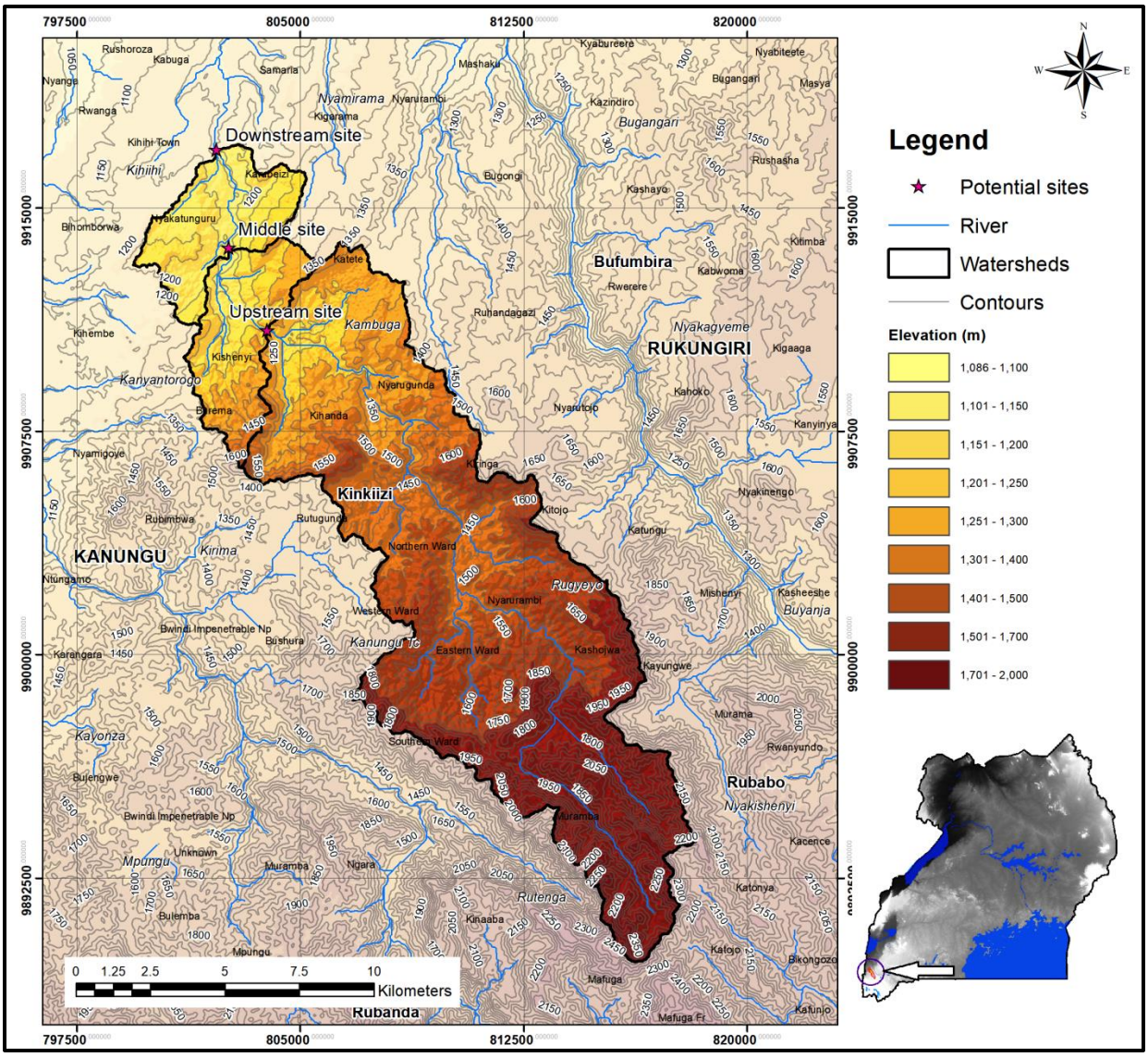
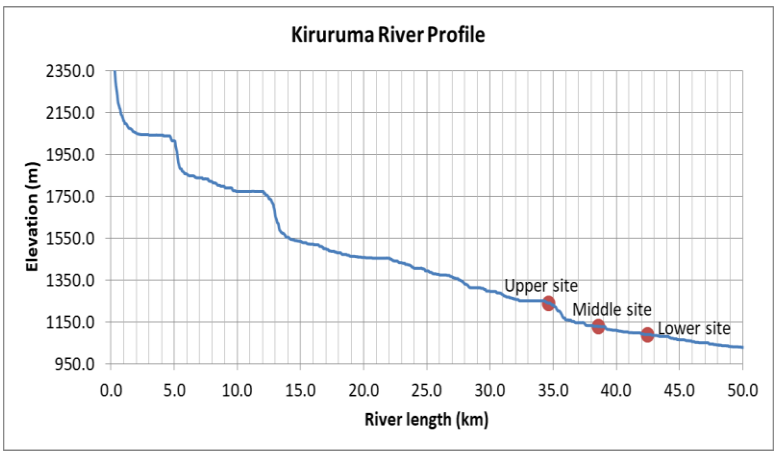


Figure 8-1: Site catchments

COMPARISON OF THE SITES

Whereas the dam is to serve total of 9000 Ha, the pipeline network distribution only covers 4420 Ha under the current design. Based on findings made during the feasibility study stage, the total area to be irrigated is around 4200 ha (4420Ha) and based on assessments. The water demand for irrigation varies between

300,000 m^3/month to over 2.5 million m^3 in June. Considering other losses and environmental flow requirements, the storage required to meet the above demand is at 7-9 million m^3.



From Table 8-1 above, the following conclusions can be drawn;

- Lower site – it has the largest catchment and therefore the largest discharge at 2.3m^3/s. The required dam height to store a sufficient volume of water is about 30 m. However, the site dictates that the dam crest length would have to be at least 320 m long to meet the necessary volume of water.
- Middle site – flow rate is at about 2.0 m^3/s. The required dam height to store a sufficient volume of water to meet irrigation water requirement is more than 30 m. At 46 m dam height, the reservoir storage volume would be about 12.7 million m^3 and the crest length would be more than 280 m.
- Upper site – it has the lowest runoff at 1.84 m^3/ which is still sufficient to meet the irrigation demands. A 20 m high dam would impound more than 14 million m^3/s. It would also have the shortest crest length at 108 m for such a large storage volume.

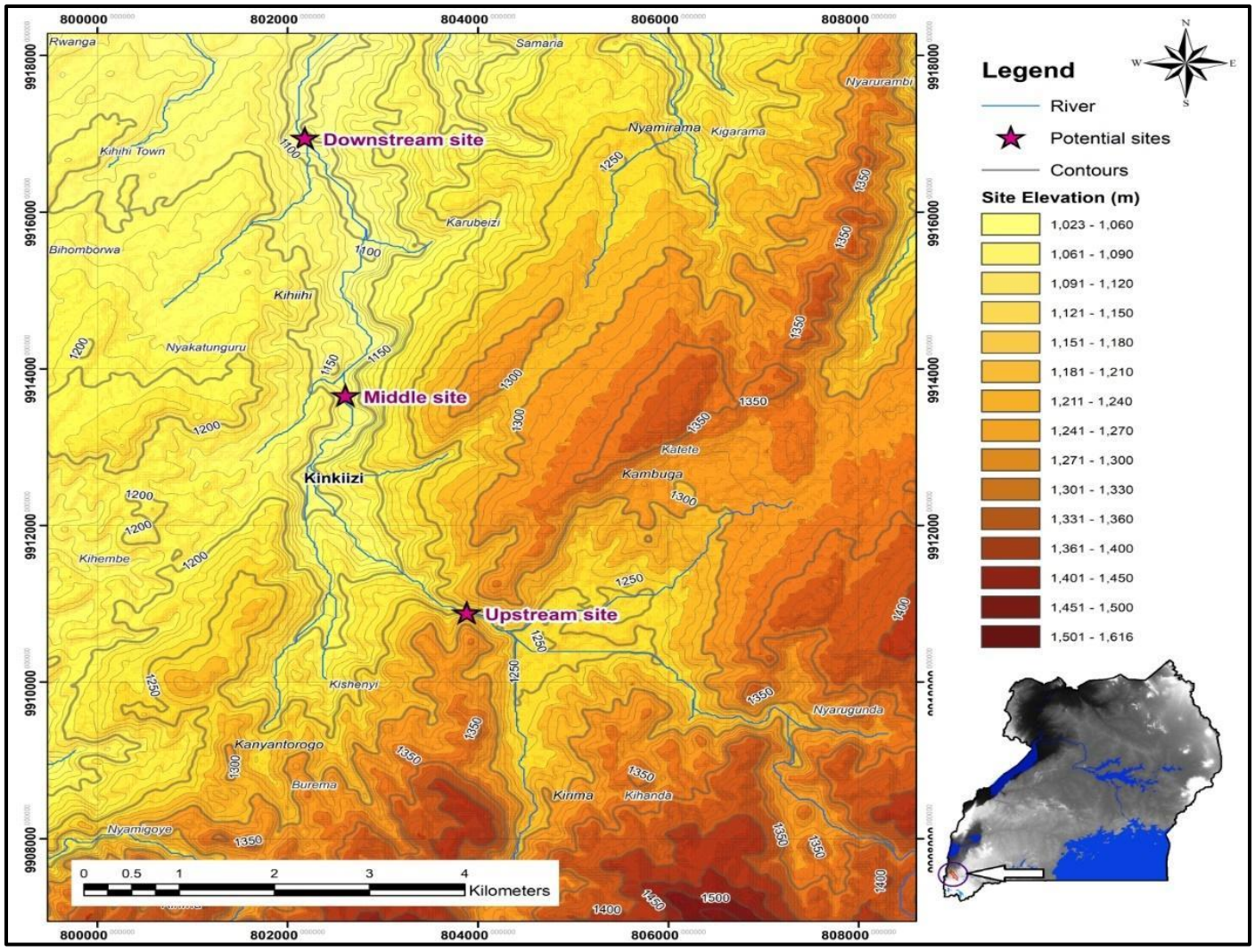


Figure 8-2: Assessed potential dam sites

From the above, the Upper dam site at Kanyungusi offers the best conditions for impoundment. A dam height of about 20 m would impound more than 14 million m^3 of water. The dam length for this height is about 110 m. Hence the scheme dam is proposed to be located on river Kiruruma in Mutojo, Nyakishojwa, Ibarya, Kanyungutsi villages at geographical coordinates of (Latitude: 0804274.07m, E, Longitude: 9910390.48m S).


Photo 8-1: River Kiruruma

At the time of investigation 2019 and the RAP study of 2023, the proposed upstream dam site location at Kanyungusti was being used as gardens for cultivating food crops including maize, beans and groundnuts.The RAP covering these aspects was developed and submitted for approval as a separate volume by the Chief Government Valuer and the World Bank.

8.1.2 Scheme command area location alternatives

During the feasibility study conducted for Matanda Irrigation scheme, various extent options of command area that can be irrigated have been come up with as presented in Table 8-2. However, the final Feasibility study command area extent covers 9000 Ha command area extent covering; 5 sub counties; Kihiihi, Kihiihi Tc, Nyakinoni, Nyamirama and Nyanga sub counties, 58 parishes and 158 villages.

The analysis of scheme location alternatives considered 9,000 Ha. The water resources, hydrology, hydraulic analysis and irrigation water requirement considered 9,000 Ha at the design stage of the Dam. The ESIA update that took place in November 2023 also considered a command area of 9,000 Ha.

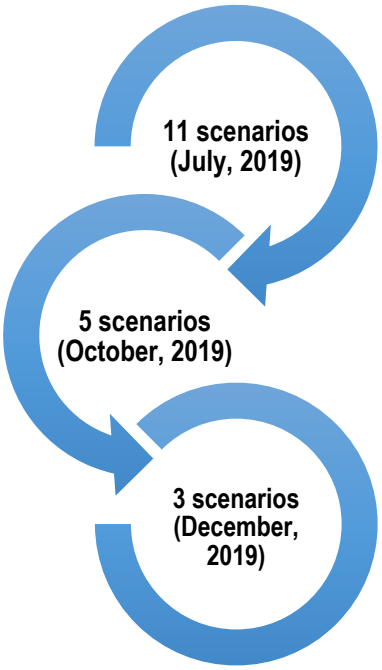
Table 8-2: Feasibility study command area extents

Feasibility study stage	Command area
Inception phase (November, 2018)	4750 Ha
Interim Report (July, 2019)	690 ha – 4750 Ha
Draft Feasibility Study Report (October, 2019)	2180 ha – 4700 ha
Detailed Feasibility Study Report (December, 2019)	4420 ha
Detailed ESIA studies (November 2023)	9000 ha

The command area will easily amalgamate with the farming pattern since the delineated villages are currently practicing subsistence farming. Therefore, from an environmental point of view, in terms of character, the proposed project bears no significant change in character with surrounding. This is based on the existing environmental guidelines and procedures, as stipulated in the National Environment Act No 5 of 2019.

8.2 Design Options/Scenarios

Under the feasibility study, different scenarios were developed to check the water availability and success rate of scheme with and without dam conditions for various water demands. Upon various engagements, 3 (three) scenarios were selected, out of 11 scenarios to work out the extent of command area that can be irrigated without dam and with dam of different heights and their cost and benefits to arrive at a conclusion on final option.



A. Summarized analysis of 11 scenarios (July 2019)

11 scenarios were taken into consideration by the feasibility study to work out the extent of command area that can be irrigated without dam and with dam of different heights, cost and benefits (Table 8-3).

Table 8-3: Scenarios Developed for Sensitive Analysis

Scenario	Description of Scenario	Criteria/Input	Provision to other Uses	Height of Weir/ Dam (m)	Command Area can be Irrigated (Ha)
1	Without Dam (Diversion Weir)	• 75% dep. Inflows is 0.925 m3/sec. • Irrigation demand corresponding to extent of command area that can be irrigated. • Ecological flow 10% in dry & 20% in wet seasons. • On daily simulation basis. • 100% success rate is to be ensured.	10%	6.00	980
2			15%		840
3			20%		690
4	With Dam (17.50M)	• Monthly Inflow into Reservoir. • Irrigation demand corresponding to extent of command area that can be irrigated. • Ecological flow 10% in dry & 20% in wet seasons. • On monthly Simulation. • 82% success rate on yearly basis with allowing 15% deficit is to be ensured.	10%	17.50	4260
5			15%	17.50	3810
6			20%	17.50	3410
7	With Dam (19.50M)		10%	19.50	4750
8			15%	19.50	4400
9			20%	19.50	3920
10	Dam Height to Irrigate total potential Command Area		15%	20.50	4750
11			20%	22.50	4750

Scenario wise Total Cost and Unit Cost of the Scheme

Scenario	Provision to other Uses	Command Area can be irrigated	Lowest Bed Level	MDDL	FRL	Storage at MDDL	Storage at FRL	Height of dam	Length of Dam	Cost of the Project	Cost per Ha.
		(Ha)	m	m	m	MCM	MCM	m	m	M.USD	USD
6	20%	3410	1130	1140	1145	0.741	1.901	17.5	53	37.848	11,099
9	20%	3920	1130	1140	1147	0.741	2.495	19.5	60	41.539	10,596
11	20%	4750	1130	1140	1150	0.741	3.559	22.5	140	48.602	10,232

Scenario 11 was recommended since the unit cost of the scheme per ha was less compared to other scenarios.

B. Summarized analysis of 5 scenarios (October, 2019)

Out of the 11 pretested scenarios, 5 scenarios where further considered to work out the extent of command area that can be irrigated without dam and with dam of different heights, cost and benefits in consideration of the minimum environmental and other flow of 0.975 cumecs throughout the year (Table 8-4).

Table 8-4: Selected scenarios narrowed down for further analysis

Scenario	Description of Scenario	Criteria/Input	Height of Dam (m)	Command Area can be Irrigated (Ha)
1	**Without Dam** (Diversion Weir)	• Ecological and other flow is 0.975m3/sec throughout year. • Irrigation demand corresponding to extent of command area that can be irrigated. • 82% success rate on yearly basis with allowing 15% deficit is to be ensured	6	0
2	**With Dam** (FRL: +1145M)		36.7	2180
3	**With Dam** (FRL: +1150M)		41.7	3580
4	**With Dam** (FRL: +1155M)		46.7	4420
5	**With Dam** (FRL: +1160M) to Irrigate total potential Command Area		51.7	4700

The unit cost (cost per hectare) of each scenario was worked out to narrow down the best feasible scenario of the scheme. The unit cost per hectare along with the basic parameters was as follows (Table 8-5).

Table 8-5: Selected scenario-wise unit and total costs

Scenario	Command Area	FRL	Storage @ FRL	Height of Dam	Length of Dam	Cost of Scheme	Cost per Ha
	(Ha)	(m)	(MCM)	(m)	(m)	(MUSD)	(USD)
Scenario-2	2180	+1145	7.147	36.7	334	41.22	18,908
Scenario-3	3580	+1150	10.536	41.7	470	55.03	15,369
Scenario-4	4420	+1155	14.835	46.7	727	76.96	17,412
Scenario-5	4700	+1160	20.686	51.7	864	90.44	19,243

A financial and economic analysis including sensitivity analysis was carried out for all five scenarios, of which scenario 2 was more technically and economically feasible as presented in Table 8-6. However, it was suggested the possibility of extending the command area to about 4420 Ha in between scenario 3 and 4.

Table 8-6: Selected scenarios from the financial and economic analysis

Description		Scenario-2	Scenario-3	Scenario-4	Scenario-5
CCA (Ha)		2180	3520	4420	4700
Total Cost of Project (Million USD)		41.22	55.03	76.96	90.44
Cost/Ha (USD)		18908	15634	17412	19243
Financial analysis					
FIRR (%)		23	28	25	23
FNPV (USD)		61,721,232	116620267	134,873,423	130,756,943
FB-C RATIO		1.74	1.99	1.85	1.72
Sensitivity analysis					
I	FIRR (%)	18.36	22.43	20.06	18.01
	FNPV (USD)	46,559,014	96,378,229	106,564,731	97,489,817
	FB-C RATIO	1.47	1.70	1.57	1.45
II	FIRR (%)	20.32	24.62	22.12	19.95
	FNPV(USD)	47,216,016	93,199,002	105,463,765	99,484,231
	FB-C RATIO	1.57	1.79	1.66	1.55
III	FIRR (%)	15.90	19.63	17.46	15.58
	FNPV (USD)	32,053,798	72,956,963	77,155,074	66,217,104
	FB-C RATIO	1.33	1.53	1.41	1.31
Economic analysis					
EIRR (%)		18	22	20	18
ENPV (USD)		36,176,011	75,372,938	83,079,901	75,682,384
EB-C RATIO		1.44	1.65	1.53	1.42
Sensitivity analysis					
I	EIRR (%)	13.96	17.42	15.41	13.66
	ENPV(USD)	21,013,793	55,130,899	54,771,209	42,415,257
	EB-C RATIO	1.21	1.40	1.29	1.20
II	EIRR (%)	15.55	19.18	17.08	15.24
	ENPV (USD)	24,278,431	56,162,167	58,957,285	50,031,639
	EB-C RATIO	1.29	1.48	1.37	1.28
III	EIRR (%)	11.77	14.96	13.11	11.49
	ENPV (USD)	9,116,213	35,920,128	30,648,593	16,764,512
	EB-C RATIO	1.09	1.26	1.16	1.08

I - Increase cost by 25% and keeping benefit constant
II - Keeping cost constant and decrease benefit by 10%
III - Increase cost by 25% and decrease benefit by 10%

C. Summarized analysis of 3 scenarios (December, 2019)

As seen from the results, no irrigation is possible without dam duly ensuring success rate desired. Even in with dam condition, the height of dam got increased. The reason for that is the inflow in more than 30% days in dry and 10% days in wet are less than 0.975 cumecs (min environmental flow). Therefore; 0.975 m^3/sec min environmental flow throughout year, Tennant Method for Excellent Flow Condition: 30% in dry and 50% in wet season, and Tennant Method for Good Flow Condition: 20% in dry and 40% in wet season were considered. Out of the 5 pretested scenarios (Table 8-7), scenario 4 was selected and 3 optional scenarios (Table 8-7) where recommended from each environmental flow condition for irrigating 9000 ha of command area.

Table 8-7: Summary of scenarios as per environmental flow condition

Scenario	FRL (m)	Storage @ FRL	MDDL (m)	Storage @ MDDL	DBL (m)	Dam height upto FRL (m)	Free Board (m)	Total Dam Height (m)	Command Area (Ha)
I - Environmental Flows As per ESIA Report (0.975 cumecs Constantly									
Scenario-1	Without Dam - Not Feasible								
Scenario-2	1145.00	7.147	+1127	0.724	+1111.3	+33.7	3	+36.7	2180
Scenario-3	1150.00	10.536	+1127	0.724	+1111.3	+38.7	3	+41.7	3580
Scenario-4	1155.00	14.835	+1127	0.724	+1111.3	+43.7	3	+46.7	4420
Scenario-5	1160.00	20.686	+1127	0.724	+1111.3	+48.7	3	+51.7	4700
II - Environmental Flows for Good Flow Conditions (20% in dry & 40% in Wet seasons)									
Scenario-1	Without Dam - Not Feasible								
Scenario-2	1128.00	0.890	+1127	0.724	+1111.3	+16.7	3	+19.7	2180
Scenario-3	1132.00	1.742	+1127	0.724	+1111.3	+20.7	3	+23.7	3580
Scenario-4	1135.50	2.739	+1127	0.724	+1111.3	+24.2	3	+27.2	4420
Scenario-5	1137.00	3.247	+1127	0.724	+1111.3	+25.7	3	+28.7	4700
III - Environmental Flows for Excellent Flow Conditions (30% in dry & 50% in Wet seasons)									
Scenario-1	Without Dam - Not Feasible								
Scenario-2	1132.00	1.742	+1127	0.724	+1111.3	+20.7	3	+23.7	2180
Scenario-3	1136.00	2.899	+1127	0.724	+1111.3	+24.7	3	+27.7	3580
Scenario-4	1140.30	4.622	+1127	0.724	+1111.3	+29	3	+32	4420
Scenario-5	1141.00	4.954	+1127	0.724	+1111.3	+29.7	3	+32.7	4700

Observations:

1.Dam height gets reduce by 17 to 23m for Good Flow condition for different extent of command area.

2.Dam height gets reduce by 13 to 19m for Excellent Flow condition for different extent of command area.

3. For potential command area, Dam height reducing by 19, 23m for Excellent and Good Flow condition respectively.

D. Final scenario

Table 8-8: Finalized best feasible scenario of the scheme.

SCENARIO-A	Irrigation water requirement for 4420 ha command area plus 0.975 m^3/sec for environmental releases
SCENARIO-B	Irrigation water requirement for 4420 ha command area plus 30%, 50% of AAF in dry, wet periods respectively (Excellent Flow Condition) towards environmental releases.
SCENARIO-C	Irrigation water requirement for 4420 ha command area plus 20%, 40% of AAF in dry, wet periods respectively (Good Flow Condition) towards environmental releases

Scenario	Environmental Flow	FRL (m)	Storage @ FRL (MCM)	MDDL (m)	Storage @ MDDL (MCM)	Deepest Bed Level (m)	Height of Dam at FRL (m)	Free Board (m)	Total Dam Height (m)	Command Area (Ha)
Scenario-A	0.975cumecs	+1155.00	14.835	+1127	0.724	+1111.86	43.14	3	46.14	4420
Scenario-B	***EF : 30%/50%***	***+1140.00***	***4.479***	***+1127***	***0.724***	***+1111.86***	***28.14***	***3***	***31.14***	***4420***
Scenario-C	GF : 20%/40%	+1137.00	3.247	+1130	1.277	+1111.86	25.14	3	28.14	4420

From the three scenarios above, Scenario-B was adopted.

8.3 Dam types

Dams are broadly classified into two types as flexible dams and rigid dams based on the materials used. A dam is said to be Rigid Dam if it is constructed using rigid construction materials such as masonry, concrete, steel, timber etc., and Flexible Dam if it is constructed using earth fill and rock fill materials.

Three different types of dams were considered for Matanda Irrigation Scheme as follows:

Roller Compacted Concrete Dams	Roller-compacted concrete dams have many similarities with conventional gravity concrete dams. The dam is built to required height and depth where it can resist the expected forces from the water by its weight. But instead of using rock-fill or earthfill, RCC Dam consist of concrete which is spread in thin layers and compacted by vibrator rollers. It is important to provide the RCC Dam with sufficient resistance to water leakage (seepage). The method of using a concrete with higher binder close to the upstream face will decrease the permeability by creating a water tight barrier of concrete with higher quality. RCC Dam is much heavier and thus demand better bedrock allowing the stresses produced by the dam weight and the water pressure. If the bedrock is heavily foliated, the foundation will suffer from shearing failure. Before and during construction of RCC Dam, the geological conditions at the site must be investigated much more thoroughly than a Rockfill dam.

Construction materials used for construction of Roller Compacted Concrete (RCC) Dams are a) Cementitious Materials b) Aggregates, c) Water, d) Chemical admixtures. Out of these, Cementitious material is playing a major role in the reduction of cost. Cementitious Materials consists of Portland cement and pozzolan.

Fly Ash (Class F and Class C) is most used as a pozzolan or mineral filler for RCC. Fly ash and aggregates of 15 cm size generally up to approximately 50% by volume used to replace cement to reduce cost and acts as mineral filler to improve workability. RCC dam is economical where fly ash is available abundantly.

Roller-compacted concrete has several advantages and disadvantages when compared to traditional dam construction.

Advantages of RCC Dams:

- Heat of hydration generated becomes important factor in the RCC dams as the extent of thermal cracking will be affected by the type and degree of temperature control.
- In RCC dams, temperature control is done by selecting low- heat-of-hydration cement and addition of fly ash.
- Air entrainment, tiny air bubbles in cement, allows freezing water a place to expand into, and consequently reduces any damage associated with freezing and thawing conditions in RCC dams.
- RCC dams can be constructed faster than conventional concrete gravity dams because the construction involves use of readily available equipment such as rollers and graders.
- RCC dams take advantage of locally available materials.
- RCC dams are less prone to damage and cracking in case of earthquakes. The seismic risk is low with return period of 50 years.
- Seepage through RCC dams can be controlled by 'jacketing' the RCC in ordinary reinforced concrete.
- Gravity dams are well adapted for use as an overflow spillway crest. Earth dams cannot be used as overflow dams. A gravity overflow dam is often used for the spillway feature of earth and rock-fill dams.

Disadvantages of RCC Dams:

- Roller compacted concrete may not be adoptable in small dam due to less volume consideration.
- More infrastructure, machineries and equipment are needed for the RCC dam compared to embankment dams.

	● In-place properties of concrete are highly dependent on field quality control. As the concrete is placed in layers there can be very poor bond between the layers. ● The tensile strength can be very low, and permeability can be very high in case of incomplete compaction. ● Time required for RCC to set for adequate support of form works in short structure determines RCC placement time. For construction of training walls at perpendicular to the dam axis, the manoeuvring of machineries for laying and compaction of concrete up to the required standard quality becomes difficult.
Earthen Embankment	An earthen embankment is a raised confining structure made from compacted soil to confine runoff either for surface storage or for ground water recharge. These are also used for increasing infiltration; detention and retention of water to facilitate deep percolation and also to provide additional storage as in the case of semi dug-out ponds. The cross-section of embankments is usually trapezoidal in shape. When constructed across natural channel to induce channel storage, the embankment also called earthen dam. Further, the embankment depends on its own weight to resist against sliding and overturning whereas foundation work is also included in case of dam. Embankment dams are of two types, namely Earth-filled dam (also called an earthen dam or terrain dam) made of compacted earth, and the Rock-filled dam. The cross section of the embankment dam will be similar to hill or a bank. Most of the embankment dams have a central section or core composed of an impermeable material to stop water from seeping through the dam. The core can be of clay, concrete, or asphalt concrete. These types of dams are good choice for sites with wide valleys. They can be built on hard rock or softer soils. For a rock-fill dam, the rock pieces are to be exploded or crushed into smaller grades to get the required size in an embankment dam. Advantages of earthen embankment/dam: ● Natural materials available around the site are used. ● Design procedures are simple. ● Comparatively small plant and equipment are required. ● Use of costly manufactured items like cement and steel is eliminated and there is saving on transportation costs also. ● Foundation requirements are less stringent than for other types of dams. The broad base of an earth dam spreads the load on the foundation. ● Earth fill dams resist settlement and movement better than more rigid structures and can be more suitable for areas where earth movements are common.

	Disadvantages of earthen embankment/dam: ● An earth embankment is easily damaged or destroyed by water flowing on, over or against it. Thus, a spillway and adequate upstream protection are essential for any earth dam. ● Designing and constructing adequate spillways is usually the most technically difficult part of any dam building work. Any site with a poor-quality spillway shall not be used. ● If it is not adequately compacted during construction, the dam will have weak structure hence prone to seepage. ● Earth dams require continual maintenance to prevent erosion, tree growth, subsidence, animal and insect damage and seepage.
Concrete Gravity Dams	A Gravity dam is defined as a solid structure, made of concrete or masonry, constructed across a river to create a reservoir on its upstream. The section of the gravity dam is approximately triangular in shape with its apex at its top and the maximum width at the bottom. The section is so proportioned that it resists the external force acting on it by its own weight. This type of structure is most durable and requires very little maintenance. They can be constructed with ease on any dam site, where a natural foundation strong enough to bear the enormous weight of the dam is available. Nowadays, concrete gravity dams are mostly preferred where the availability of natural materials and binder replacements are inadequate. Newer dams of this type are typically composed of unreinforced concrete monoliths with seals at the joints. A suitable foundation for a gravity dam such as a sound rock foundation shall be available. The river-valley at the dam site shall preferably have a narrow gorge to reduce the dam. However, the gorge shall be open out upstream to provide a large basin for a reservoir. The general bed level at the dam site shall preferably be higher than that of the river basin. This will reduce the height of the dam and will facilitate the drainage problem. Advantages of Concrete Gravity Dam ● Gravity dams are relatively stronger and more stable than earth dams. They are particularly suited across gorges having very steep side slopes where earth dam, if constructed, might slip. ● Gravity dams are well adapted for use as an overflow spillway crest. Earth dams cannot be used as overflow dams. A gravity overflow dam is often used for the spillway feature of earth and rock-fill dams. ● They can be constructed of any height, provided suitable foundations are available to bear the stresses. ● The height of an earth dam is usually limited by the stability of its slopes requiring a

	very wide base width. Highest dams in the world are made of gravity dams only. ● Gravity dam is suited to such areas where there is likelihood of very heavy downpour. The slopes of earth dam might get washed away in such a situation. ● They require the least maintenance. ● The failure of this dam is not sudden. It gives enough warning time before the area to downstream side is flooded due to the damage of the structure. On the contrary, an earth dam generally fails suddenly. ● Deep-set sluices can be used in the gravity dams, to retard the sedimentation or silt deposit in the reservoir. The trap efficiency of a reservoir of an earth dam is more than that of a reservoir of gravity dam. ● They are cheaper in the long run since it is more permanent than any other type. Thus, the benefit-cost ratio of such a dam is always higher. Disadvantages of Concrete Gravity Dam ● Gravity dams can be constructed only on sound rock foundations. They are unsuitable on weak foundations or on permeable foundations on which earth dams can be constructed with suitable foundation treatment. ● The initial cost of a gravity dam is always higher than an earth dam. Hence, where funds are limited and where suitable materials are available for the construction of an earth dam, the earth dam may be preferred. ● If mechanized plants, such as manufacturing and transporting mass concrete, curing of concrete etc. are not available, a gravity dam may take more time to construct. ● They require skilled labour or mechanized plants for its construction. ● It is very difficult to allow subsequent rise in the height of a gravity dam unless specific provisions have been made in the initial design.

Table 8-9: Summary of Site-Specific Analysis for selection of the Dam Type

Criteria	Earth embankment	Concrete Gravity Dam	Roller Compacted Dam
Topography: The site for Matanda dam is a narrow U-shaped valley. The river flows between high (gneiss) rocky walls.	A low plain country would suggest an earth fill dam with separate spillways. **Unsuitable**	A narrow U-shaped valley, i.e., a narrow stream flowing between high rocky walls, would suggest a concrete overflow dam. **Suitable**	A narrow U-shaped valley, i.e., a narrow stream flowing between high rocky walls, would suggest a roller compacted (RCC) dam with concrete overflow dam. **Suitable**
Geology and Foundation Conditions Matanda dam site is underlain by a competent gneiss rock. Since the dam site is in a seismic zone 1, seismic analysis was done as part of the dam design to determine the response of the dam to seismic forces. Simulations for earthquakes were performed and the dynamic response of the dam structure determined and adequate factor of safety provided. This response includes displacements, and both tensile and compressive stresses.	Silt and fine sand and gravel foundations are suitable for earthen and rock fill dams. **Unsuitable**	Rock foundation is suitable for concrete gravity dam. **Suitable**	Rock foundation is suitable for concrete gravity dam. **Suitable**
Availability of materials: In order to achieve economy in the dam, the materials required for its construction must be available locally at short distance from the construction site.	Materials needed include gravel of adequate quality and clay materials for the dam core. Gravel material (600,000m^3) was available at Kinyantorogo, 6 Km from the dam site. **Suitable**	Two (2 no.) sand sources at Kiruruma (400,000m3) and Buhumurilo cells (720,000m3), were identified. They are about 8 Km from the dam site. Adequate aggregates/ stones (1,500,000m3) are available at a quarry	Two (2 no.) sand sources at Kiruruma (400,000m3) and Buhumurilo cells (720,000m3), were identified. They are about 8 Km from the dam site. Adequate aggregates/ stones (1,500,000m3) are available at a quarry located 12 Km from the site. **Suitable**

Criteria	Earth embankment	Concrete Gravity Dam	Roller Compacted Dam
		located 12 Km from the site. **Suitable**	
Height of dam: Total dam height for Matanda is 32m.	Suitable for dam height less than 30 m. **Unsuitable**	Can be constructed to any height. **Suitable**	Can be constructed to any height. **Suitable**
Spillway size and location: The Matanda dam site is a U-shaped valley with no space/location for a separate spillway. The spillway shall be located on the dam body (i.e., overflow dam type needed).	Earth dams are usually non-overflow dam type. At Matanda there is no space for separate spillway. **Unsuitable**	Spillway can be constructed on the dam body. **Suitable**	Spillway can be constructed on the dam body. **Suitable**

Based on site-specific conditions for Matanda, the analysis above indicates that, overall, the earth embankment dam is not suitable for the Matanda dam site. The two potential options for Matanda are either Convectional Concrete Dam (CCD) or Roller Compacted Concrete (RCC) Dam.

Table 8-10: Stage 2 Selection between a Conventional Concrete Dam and an RCC Dam

Criteria	Concrete Gravity Dam	Roller Compacted Dam
Construction Timeline: There is need to complete construction of the dam due to: (i) expiry of the bank credit; (ii) high cost of river diversion for a long time; (iii) two rainy seasons that can affect the quality and completion of such site work.	These dams are usually built in large Blocks hence requiring time-consuming activities e.g., erection of formwork; adequate curing of concrete. Estimated time for construction is about 30 months. **Not recommended**	The RCC dam are usually built in thin, horizontal lifts, which allows rapid construction. Construction time is estimated to be 18 months. **Recommended**
Mechanized construction	Highly labor intensive due to requirements for formwork and placing of concrete. Skilled manpower for this massive type of construction is not readily available in Kanungu district. These will have to be sourced from elsewhere hence a high cost of construction. **Not recommended**	Constructed mainly using machines like rollers, tractors, and graders to place and compact the mixture. Hence higher speed of construction. **Recommended**
Estimated Construction costs for the dam.	Construction costs for the conventional concrete dam have been estimated at USD. 13.76 Million.	The appended BoQs indicate that the cost of the RCC dam (i.e., head-works) shall be:

Criteria	Concrete Gravity Dam	Roller Compacted Dam
Excluding pipework, drainage network and farm roads.		USD. 11.54 Million

Roller Compacted Concrete (RCC) dam was selected in the gorge portion for the present proposal also due to the following reasons:

- There are steep slopes on both flanks with deep gorge portion which is not suitable for earthen embankments.
- The total length of dam is considerably small (105 m only). RCC dam suits the best compared to other types.
- RCC dams shall be quicker to construct and can take advantage of machinery that are available in Uganda.
- RCC dams are economical where fly ash and coarse aggregates (up to 15 cm) are available abundantly. The material report indicates that sufficient quantities of aggregates can be obtained within 15 Km radius for construction of a RCC Dam.
- Possibility of using available materials (sand and gravel) with well-designed binder dosage between 60 and 90 kg per m3.)
- Upstream waterproofing shall be ensured by a reinforced concrete or geo-membrane lining connecting to a plinth.

8.4 No Project Option

Analysis of the "no project option" as an alternative is an important component of the ESIA, it provides an environmental baseline against which impacts of the proposed action can be compared. The "no project option" alternative here means that the status quo is maintained (undeveloped), meaning that the proposed Matanda Irrigation Scheme is NOT implemented. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. This particular option cannot be a means to achieving the objectives of the proposed project. In fact, it's the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- There will be no added values to the proposed project site.
- Farmers in the project areas will have no access to irrigation and other agricultural services the project would provide that includes road infrastructure improvement, specifically access roads to the project area.
- Existing land will remain underutilized.
- The local skills, manpower and creativity would remain under-utilized in the agricultural sector.
- There will be no expanded land under irrigated agriculture in the district. Since the only mini demonstration irrigation scheme on River Ntungwa (formed downstream of the confluence of River Mitano and River Kiruruma) under the presidential pledge covers only 10 acres of land.

This option would however do away with any potential negative impacts such as noise, water, air, and soil pollution; influx of workers and related pressure on existing resources, waste, soil erosion, land take and accidents, among others.

From the analysis above, it becomes apparent that the No Project Option is no alternative to the community, Kanungu local government administration and the Government of Uganda since it does not offer comparative benefit to society, unless a safer alternative is adopted by the project, the proposed construction will be a core stone of development to the current setup of the area.

8.5 Irrigation method options

The suitable irrigation method is always recommended to economize water in agriculture and to bring more area under irrigation, reduce the cost of irrigation on unit land, increase the yield per unit area and unit quantum of water. Conventional and modern irrigation methods were compared as presented in Table 8-11.

Table 8-11: Compared irrigation methods

Performance Indicator	***Conventional Irrigation Methods***	***Modern Irrigation Methods***
Water Saving	Huge Losses due to percolation, runoff and evaporation	Up to 70% water can be saved over conventional irrigation methods. Runoff and Percolation Losses are nil or negligible.
Water Use Efficiency	30-50% only	80-95%
Labour	All operations are manual and hence labour requirement is high	Labour needed only for initial operation and periodic maintenance.
Weed Infestation	High	Very less or Nil
Diseases and Pest Problems	Very High	Relatively less due to reduced atmospheric humidity.
Soil Suitability	Percolation is more in light soils-Runoff loss is more in heavy soils	Since flow rates can be controlled, suitable for all types of soils.
Water Control	Inadequate	Very precise and easy
Efficiency of Fertilizer use	Low due to leaching and run-off	Very high since applied at the root zone.
Soil Erosion	High	Nil
Crop Yield	Non uniformity in available moisture reduces the Yield	Frequent and right quantity watering eliminates moisture stress. Yield increase of 40-125% over conventional method.

The water conveyance and distribution to the command area through open canal system and adoption of surface gravity irrigation methods like check basin/ridge is not feasible. Modern methods of irrigation have surely a number of advantages over the conventional irrigation methods. Hence, closed pipeline network distribution of water to all the cropped fields is contemplated with pressurized irrigation systems; Sprinkler, Drip, Flexible Hose Irrigation System.

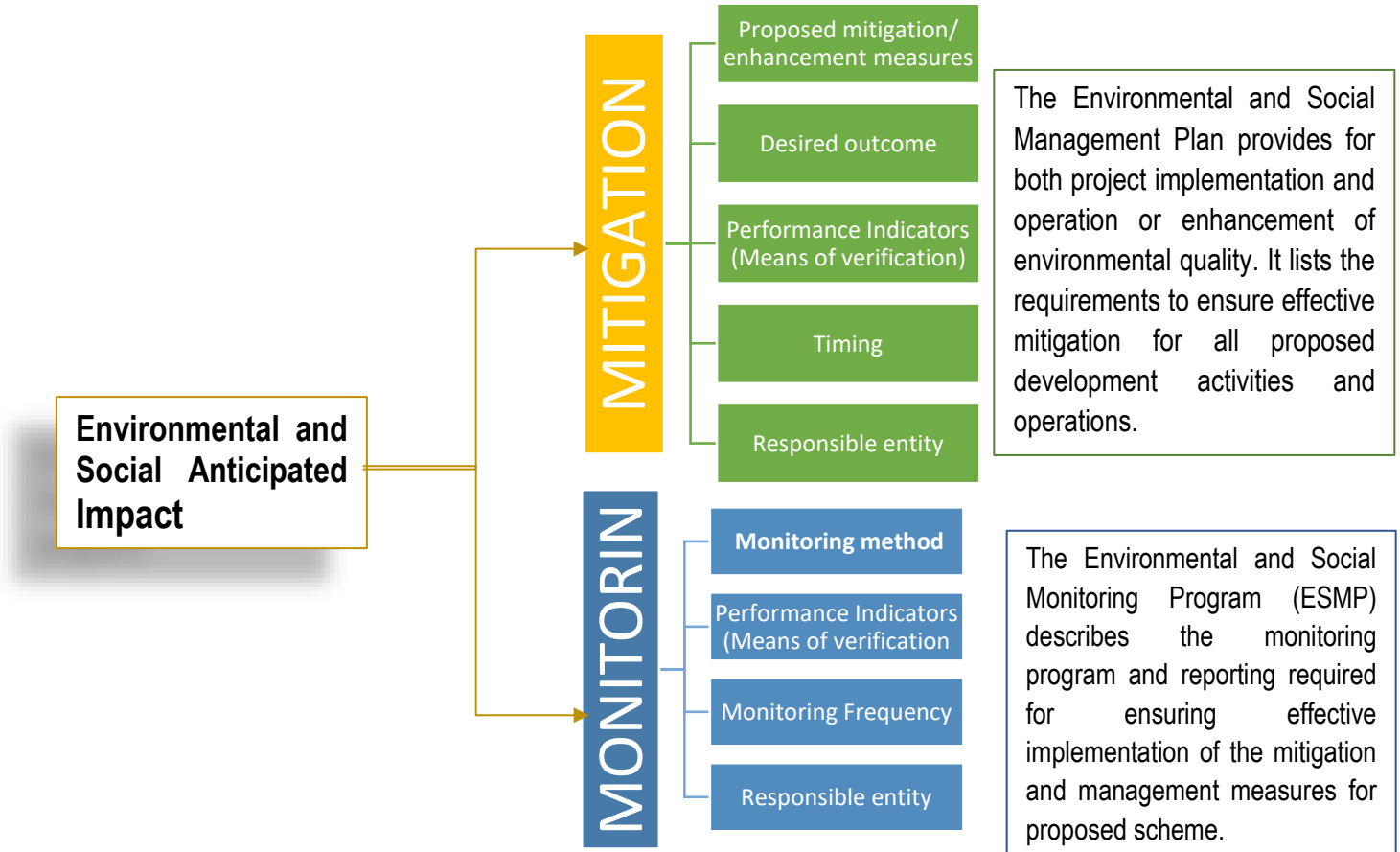
8.6 Action/ Proposed construction option

This option implies that the proposed Matanda Irrigation Scheme is implemented as per final feasibility recommendations and design in the proposed project area. This particular option means achieving the objectives of the proposed project such as, improvement of; agricultural productivity, food security, farm incomes, rural livelihood, and resilience to climate change and diminish reliance on erratic rains. To elaborate it further, this will foster Government programme of modernizing agriculture that aims at increasing incomes and improving the quality of life of poor subsistence farmers and their households. It will further ensure food security and provision of gainful employment through improved agricultural enterprise development and promotion of sustainable land use and management of natural resources; however, this option is also associated with adverse impacts (Chapter 7). Mitigation measures for the identified negative impacts of this alternative have been thoroughly discussed throughout this report and if they are implemented efficiently and effectively as proposed in the Environmental and Social Management and Monitoring Plan (ESMMP), the project very significant project benefits realized. Under the proposed option, the scheme would be issued with the project ESIA License. In issuing the license, NEMA and Kanunugu District Environmental Department would in approval of the proposed development, give conditions of environmental and social compliance during the construction period and operational phases. Basing on the above justification, the ESIA study found it appropriate to consider the project action alternative.

ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN (ESMMP)

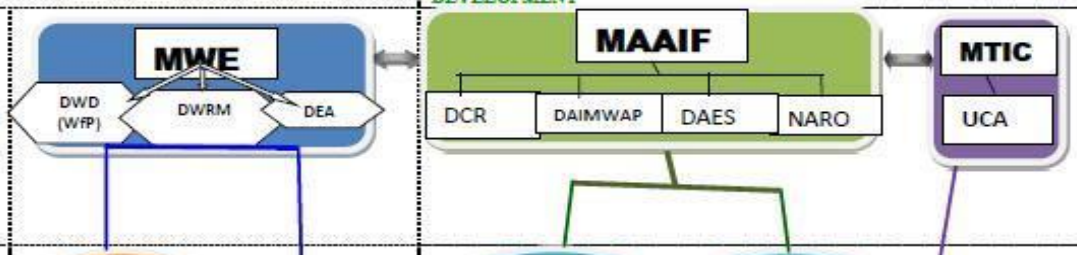
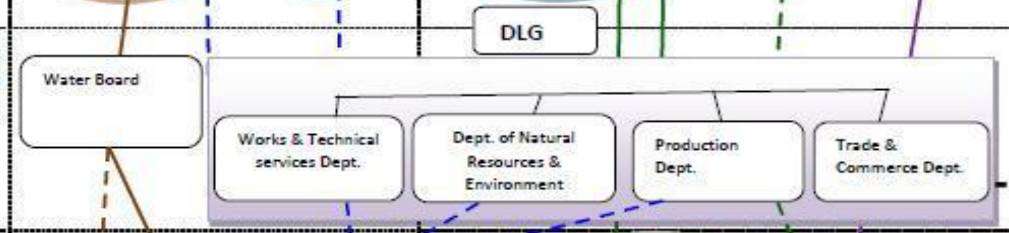
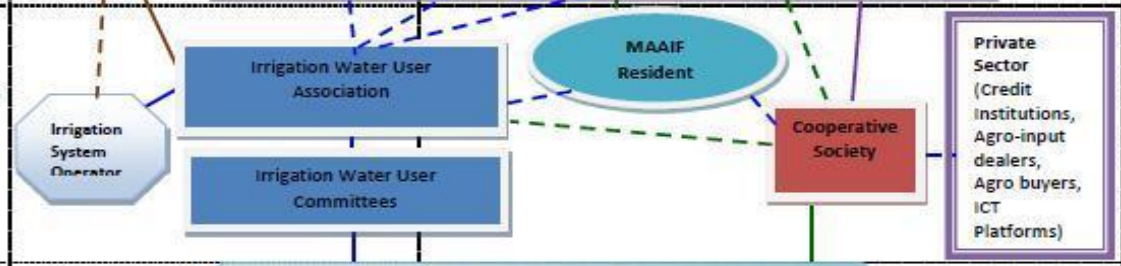
9 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN (ESMMP)

The goal of this Environmental and Social Management and Monitoring Plan (ESMMP) is to ensure that environmental and socio-economic issues continue to be fully integrated into the decisions of the scheme throughout its lifetime. It provides a framework (integration) for managing (Environmental and Social **Management** Plan-ESMP) and monitoring (Environmental and Social **Monitoring** Program-ESMP) impacts for the life of the scheme. It is designed to ensure that the commitments/mitigation measures in this ESIS, and in any subsequent assessment reports, together with any license approval or similar conditions, are implemented. This ESMMP has been designed as a summary of proposed mitigation measures, monitoring, and institutional measures to be taken during pre-construction, construction, and operation to eliminate or reduce adverse environmental and social impacts to acceptable levels as per provisions within the National legal framework and the relevant World Bank safeguards. Irrigation Development and Climate Resilience Project (P163836) Environmental and Social Management Framework (ESMF), set out the principles, rules, guidelines and procedures referenced in this ESIA and ESMMP. The time frame for implementation of these mitigation measures and monitoring is also specified. Structure of the ESMMP is as follows;



The various aspects of the ESMMP are detailed in sections below.

Table 9-1 Management of the Matanda Irrigation Scheme

MANDATE & FUNCTION	OFF FARM WATER DEVELOPMENT AND MANAGEMENT	ON-FARM WATER DEVELOPMENT & WATER USE MANAGEMENT, PRODUCTION & VALUE CHAIN DEVELOPMENT	
NATIONAL LEVEL	↓ Regulation ↓ Bulk Water ↓ Off farm O&M ↓ Major Repairs ↓ Expansion ↓ Monitoring & Supervision ↓ Envin social Impact Assts		**MAAIF**: Regulation & guideline on agricultural water use & Mgt; Planning & Development of on farm irrigation infrastructure; On farm O&M; Agronomy & Extension; Value addition & Agro-Market; Production, Research & Development; and Monitoring& Supervision **MTIC**: Monitoring and supervision of cooperative societies' activities and technical guidance in cooperatives management principles
REGIONAL LEVEL	↓ Supervision ↓ Monitoring ↓ Infrastructure Technical district Support ↓ Community support ↓ Training		↓ Research & Development ↓ Technical guidance, education and training ↓ Regional coordination of actors in production, agricultural water mgt, value chain & marketing
LOCAL GOVERNMENT LEVEL	↓ Supervise implement of water service agreement ↓ Monitoring and evaluation ↓ Planning ↓ Technical support ↓ Training		↓ Agronomy & Extension ↓ Back up on farm O&M ↓ Mobilise resources for irrigation, planning, development &O&M ↓ Data collection & Use of irrigation Information ↓ Agri-business, value addition ↓ Mobilisation of farmers, ↓ Monitoring and supervision
SCHEME LEVEL	↓ Water management ↓ O&M ↓ Security ↓ Collection of water User Fees ↓ Water tariffs ↓ Natural resources mgt ↓ IWUA implement water schedules		↓ Supervision of on farm infrstructure ↓ Technical advise to farmers in production, value chain addition, post harvest, marketing ↓ Techenical advise on on farm O&M ↓ Mobilisation of farmers ↓ Quality assurance & Supply of inputs ↓ Technical advice on agri-business, Marketing, Saving & Credit ↓ Onfarm water Scheduling ↓ Security of on farm infrastructure & Fac.
FARM LEVEL	↓ Learning ↓ Water user mobilisation ↓ Use & water mgt Bye-laws		↓ Farmer mobilisation ↓ Production ↓ Learning ↓ Saving & Credit ↓ Field plots O&M
LEGAL FRAMEWORK	1. **MOU** between MWE, MAAIF, MTIC, DLG, Board, Cooperative Society. 2. **Water Service Agreement** between MWE - WfP Regional Centre, Water Board and Irrigation System Operator. 3. **Bye-laws and Constitutions** for Cooperative Society, IWUA, IWUC and FFSs.		

9.1 Scheme Monitoring

To ensure effective implementation of the scheme, monitoring will be done throughout the project life. Monitoring will verify if predicted impacts have actually occurred and check that mitigation actions recommended in the ESIA are implemented and their effectiveness. Monitoring will also identify any unforeseen impacts that might arise from project implementation. The usefulness and effectiveness of this report will only be realized through a systematic monitoring programme. The monitoring plan will inform strategic and outline environmental decision making throughout the scheme lifecycle. All mitigation actions will be guided by prior actions undertaken on project sites.

Monitoring will be done through site inspection, review of site records (Accident Log, issuance of PPE, waste records, trainings and inductions, permits and approvals, etc.), review of grievances logged by stakeholders and any discussions with affected persons (construction workers, residents near the project facilities). Monitoring during the project operation will occur at two levels namely compliance monitoring and effects monitoring.

- **Compliance monitoring** will be undertaken to assess the level of implementation of prescribed mitigations in Chapter (7). Supervision will be key for this level of monitoring.
- The second form of monitoring will be **Effect monitoring**. This level of monitoring will evaluate the effectiveness of suggested mitigation measures in stemming impacts as predicted in the Impact chapter.

Under monitoring, both self and external monitoring will be undertaken. Self-monitoring will be undertaken by developer MWE and the contractor in construction phase and farmers in operational phase, while external monitoring will be undertaken by other agencies/ organs/ Authority, including government, Employers engineer/ consultant and a NEMA certified Environmental and Social Auditing Expert (ESAE).

For scheme construction, environmental and social monitoring will be done continuously throughout project construction period through daily, weekly and monthly inspections, meetings, discussions and review of reports to observe unsafe conditions and recommend corrective measures. Quarterly monitoring activities of the project shall include site inspection and supervision, verification of permits and assessing implementation of mitigation measures. This exercise will be jointly conducted with implementing partners (Client & Consultant). Monitoring reports will be generated and shared with the project team.

External and Social Environmental Audits shall be carried out annually throughout construction period to ensure compliance of project works with the ESMMP aspects and other safeguard requirements as per Matanda Irrigation Scheme NEMA approval certificate conditions.

Scope of the Audit

An annual audit will be carried out to track compliance of the project in line with the NEMA conditions of approval. In order to ensure that the project meets legal requirements related to air quality, water

management, waste disposal, hazardous materials handling, and other environmental aspects and social aspects, the annual audit will among others include the following scope of work:

1. Environmental Management and Pollution Prevention
2. Land Acquisition and Compensation
3. Occupational and Public Health and Safety
4. HIV/AIDS, Prevention of GBV/SEA/SH, and Gender and Social Issues
5. Policy, Legal, Regulatory and Institutional Issues

9.2 Institutional Arrangements

The institutions that will play key roles in the implementation of the ESMMP and their interaction levels of hierarchy are as summarized below;

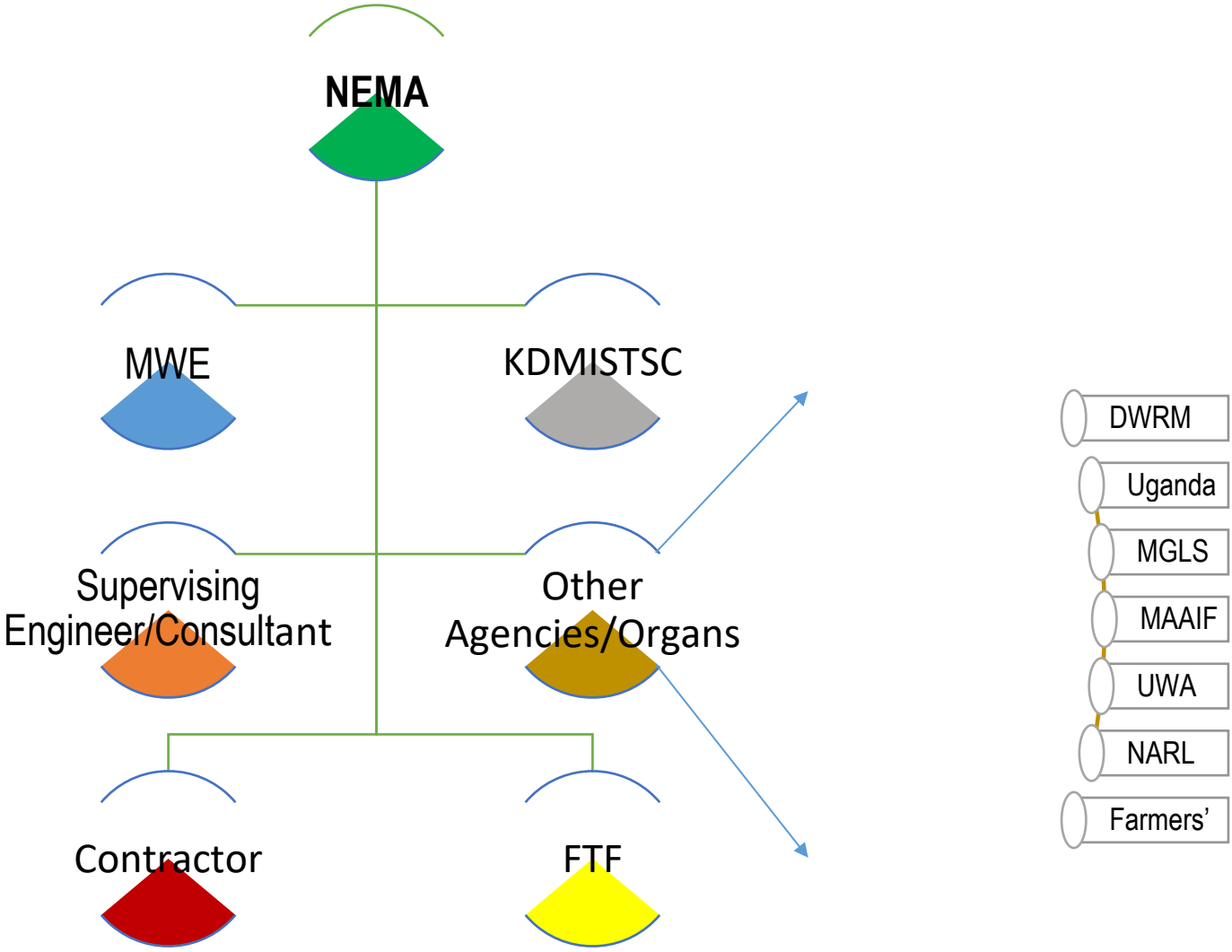


Figure 9-1: Scheme implementation Institutional Arrangements

* FTF – Farmers Task Force, MWE – Ministry of Water and Environment, DWRM – Directorate of Water Resources Management, MGLSD – Ministry of Gender Labour and Social Development, MAAIF – Ministry of Agriculture, Animal Industry and Fisheries, UWA – Uganda Wildlife Authority, NARL – National Agricultural Research Laboratories, KDMISTSC - Kanungu District Matanda Irrigation Scheme Technical Subcommittee

9.2.1 Role of NEMA as the lead Authority

Part 2 of the Fourth Schedule of the National Environment Act, 2019 defines National Environmental Management Authority (NEMA) as the lead authority for this ESMMP. NEMA is therefore mandated to ensure that project activities comply with applicable environmental laws and regulations. During all the scheme implementation phases cited in chapter 2, NEMA will;

i) First and foremost, review and assess this scheme ESIS in relation to its approval and consultation with other lead agencies. On approval, NEMA will issue an Approval certificate bearing conditions to adhere to by the project (*before project construction).*
ii) Monitor all environmental issues with a view of making an assessment of any possible changes in the environment and their possible impacts *(during both establishment and operation).*
iii) Monitor the operation of the project activity with a view of determining its immediate and long-term effects on the environment *(during project construction and operation).*
iv) Appointing an environmental inspector by the authority; that may enter the project premises at free will for the purpose of monitoring the effects on the environment of any activities carried out on the premises *(during project construction and operation)*.
v) Review and recommend conditions to be included in the Environmental and Social Audits of the project in relation to the submitted Environmental Audit TOR's (*during project construction).*
vi) Review, assess the Environmental and Social Audit reports for the projecting activities in relation to its approval conditions *(during project construction).*

9.2.2 The role of Kanungu District Local Government as a Lead Agency

Kanungu District Local Government (KDLG) will play a major role as a lead agency for this scheme in overseeing the activities and progress of the project. The district has the essential structures to enable it to play this role and it will affect this by comprising Kanungu District Matanda Irrigation Scheme Technical Sub Committee "KDMISTSC". The committee will bear such roles;

- Supervision of the Environmental and Social Monitoring Program (ESMP),
- Overseeing maintenance of scheme infrastructure, and
- Handling scheme grievances at the district level.

Specifically, the committee members will shaller the following responsibilities.

i) **Chief Administrative Officer (CAO**); the chairperson of KDMISTSC will oversee the district technical team supervisory role to project activities and scheme consultative meetings at the district.
ii) **District Engineer (DE)**; inspect the project works as per the engineering specifications and verify all acquired permits. Audit the contractors Mobilization plan and work standard operational procedures.

iii) **District Natural Resources Officer (DNRO) / District Environmental Officer (DEO)**; inspect the project sites on behalf of Kanungu District and monitor against NEMA approval project environmental conditions.

iv) **District Community Development Officer (DCDO)**; inspect the project sites on behalf of Kanungu District and monitor against NEMA approval project social conditions, review and approve community engagement minutes and reports, and assess the effectiveness of the project community engagement plan and grievance system and communication.

v) **District Labour Officer (DLO)**; inspect the project sites on behalf of MGLSD/ Kanungu District, provide clearance for workplace registration permit, monitor project site working environment in relation to OHS defined standards. Labour Management Plan, ESHS Plan, Gender Mainstreaming Plan, Training Plan and Grievance Management Plan.

vi) **District Health Officer (DHO)**; inspect project medical equipment (first aid kits) at camp sites, construction sites and axiliarry sites as well as vehicles and equipment and monitor and audit the contractors; HIV/AIDS Plan, Emergency Response and Incident Management Plan and ESHS Plan.

vii) **District Water Officer (DWO);** inspect the project works as per the engineering specifications, verify all acquired permits and offer technical advice on irrigation water issues on behalf of MWE/ Kanungu District.

viii) **District Agricultural Officer (DAO)/ District Senior Agricultural Engineer (DSAE)***;* inspect the project irrigation networks as per the agricultural water demands, Supervising and managing the agricultural command activities; Training and development programmes for scheme farmers on production methods, technologies, water and soils conservation, agricultural engineering, water harvesting and irrigation, and proper land use; Compilation and dissemination of agricultural information, data and statistics; and Technical advice on the use of chemicals and pesticides.

ix) **Town Clerk (TC);** represents Kihihi Town Council interests.

x) **Subcounty Chief (Senior Assistant Secretary, SAS);** represents; Kihiihi, Nyakinoni, Nyamirama, Nyanga, and Kanyantorogo sub counties interests, including chairing the smaller Farmers Task Force Committees (FTFC).

9.2.3 The role of Ministry of Water and Environment (MWE) (Water for Production, WfP)/ Client as a Lead Agency

MWE will have the territory role in delivering on the measures set out in the ESMMP, as the developer.

i) First and foremost, MWE will compile through its utilization of services of a NEMA registered environmental practitioners/ consultant to guide in preparation of this ESIS and submit it to the Authority in relation to its approval (before construction).

ii) Giving details of a proposed project prior to commencement and making copies of the non-technical summary of any ESIS available to stakeholders (before construction).

iii) MWE will be responsible for ensuring compliance with all relevant legislation and the relevant World Bank environmental and social safeguards, including adherence to all environmental and socio-economic mitigation measures specified in the ESMMP.

iv) MWE will procure the services of a consulting engineer bearing ESHS capacity to oversee the day-to-day implementation of the ESMMP, and to whom the contractor will report to.
v) Help in acquisition of various project permits and certificates as indicated in this ESIS.
vi) Undertake scheduled site supervision of state of environmental and social compliance.
vii) Overall supervision of this ESMMP and evaluation of its implementation.
viii) Carry out sensitization sessions of the community members and contractor about the project, safety and health measures and environmental practices.
ix) Will serve to build strong and open communication with local authorities, communities, and faith organizations among others within this project area.

9.2.4 The role of clients engineer/ supervising engineer (SE)

Supervising Engineer will have the secondary role in delivering on the measures set out in the ESMMP.

i) Responsible for ensuring compliance with all relevant legislation as well as adherence to all environmental and socio-economic mitigation measures specified in the ESMMP.
ii) Appoint a NEMA certified Environment, Health and Safety (EHS) consultant to oversee the day-to-day implementation of the ESMMP, and to whom the contractor's EHS officer will report to.
iii) Undertake scheduled site supervision of state of environmental and social compliance.
iv) Review the proposed project activities, methodologies and plans in relation to the requirements of the mitigation and management measures of this ESMMP.
v) Receive, record, investigate any grievance and order the contractor to make corrective actions and respond to the public on the corrections conducted. Work with communities to address any social issues.
vi) Review all contractors' plans including those cited in section 3.8 for approval.
vii) Validate and confirm the accuracy of monitoring results, monitoring equipment, monitoring locations, monitoring procedures and locations of sensitive receptors.
viii) Supervise Contractor's Environmental and Social Management and Monitoring Plan (C-ESMP) and performance, experience and handling of site environmental and social issues, and provide corrective instructions.
ix) Prepare the ESHS supervision statement during the construction period.
x) Participate in environmental and social inspection and monitoring by the relevant government agencies.
xi) Provide environmental and social training to the contractor prior to and during construction.

9.2.5 The Role of the Community/ Local leaders

The community leaders will have the community primary role in delivering on the measures set out in the ESMMP, as the key stakeholders.

i) Lodge complaints/ grievances on behalf of the community to the contractor, client, KDMISTSC, other government agencies and work in conjunction with respective organ to recorded community received grievances, investigate, and also recommend practicable solutions to the findings.

ii) Act as arbitrators between community and the contractor.
iii) Review progress reports compiled by contractor.
iv) Participate in the local content recruitment process by the contractor.
v) Participate in continuous sensitization of community members about the project.

9.2.6 The Role of Contractor

The hired contractor will have the primary role in delivering on the measures set out in the ESMMP, as the implementer of the designed scheme.

i) The contractor will be responsible for ensuring compliance with all relevant legislation as well as adherence to all environmental and socio-economic mitigation measures specified in the ESMMP.
ii) Preparation of the CESMMP.
iii) Acquisition of all statutory requirements.
iv) Implementation of proposed mitigation actions in the ESMMP ensuring that all environmental and social monitoring data is made available at regular intervals and that any divergences from performance standards will be fully explained, together with any necessary preventative measures.
v) The contractor shall appoint competent project and safeguards managememnt staff, including the Project Manager, Environmental Officer, Health and Safety Officer, Sociologist, and a Site Nurse, and to sign a MoU with an established health facility. The minimum qualification shall at least be a bachalors degree in a respective discipline to oversee the implementation of this ESMMP, draft a standalone contractor's ESMMP, plans and EHS-SOPs, and enforce safety and health precautionary measures for both the workers and the community at large.
vi) The contractor shall appoint a Contractor's Community Liaison Officer to bridge the gap between the contractor and the community through continuous sensitization, handling grievances, face of the project in the community and ensuring that community concerns are addressed.
vii) Implement project site layout design and projecting daily operational activities to ensure compliance with project engineering design and the ESMP with regards to environmental protection and impact mitigation.
viii) Acquisition of various project permits and certificates as indicated in this ESIS.
ix) Day to day monitoring of environmental and social matters - this will include wider environmental and social aspects including matters not directly concerned with the actual construction.
x) Awareness raising and training of contractor's staff with respect to ESHS issues.
xi) Design and conduct appropriate induction training for all workers on recruitment about ESHS while working in the project areas.
xii) Preparation of weekly and monthly environmental inspection and monitoring reports in a format acceptable to the supervising engineers and active follow-up with carrying out any corrective actions requested by the supervising engineers.
xiii) Undertake mainstreaming of gender issues into the entire project including but not limited to work placements, tools and fixtures, sanitary utilities, creating awareness on sexual harassment and any other forms of discrimination based on gender, ethnic background and race.

xiv) Ensure that all workers are provided with appropriate PPEs and further enforce their use at all times.
xv) Establishment and operatinalization of a workers grievance management system.
xvi) Ensuring that there is a workers' code of conduct.
xvii) Establishment and operationalization of policies on non-discrimination.
xviii) Contractors response mechanism on sexual exploitation, abuse, and harassment (SEAH).

9.2.7 Roles of Farmer Task Forces

A Farmer Task Force (FTF) is a group of selected farmers organized to manage, oversee, and coordinate various activities within the irrigation scheme. Its primary role is to ensure effective and sustainable operation of Matanda Irrigation Scheme while addressing the needs of the farmers.

a. Water management
b. Conflict management
c. Mobilisation of farmer groups in their respective crop value chain.
d. Dissemination of project information on agro-inputs and extension services.
e. Liasing with lead agencies on technological knowledge transfer.
f. Training of trainers.
g. Coordination of market linkages and value chain interventions.
h. Maintenance of infrastructure
i. Capacity building by improving farmers' knowledge on irrigation farming practices
j. Financial management
k. Monitoring and reporting

9.2.8 Other Agencies/ Organs

A. <u>Directorate of Water Resources Management (DWRM)</u>

Under Ministry of Water, Directorate of Water Resources Management (DWRM), Water Resources Planning and Regulation Department will bear such roles as follows under implementation of the scheme;

i) Development of Catchment Management Plans.
ii) Receive, assess the scheme Surface Water Abstraction Permit application for approval. On issue of approval, conditions will be attached to the permit to guide scheme water abstraction.
iii) Receive, assess the scheme construction application on a water body for approval. On issue of approval, conditions will be attached to the permit to guide dam construction.
iv) For the case of dredging for river diversion, it will receive, assess such application for approval of a Dredging Permit.
v) Bear input in review of this ESIS if necessitated by NEMA, as a key stakeholder.
vi) Participate in the annual scheme environmental and social audit.

B. **Uganda Police**

Kanungu Police station with the respective police posts in the command area will;

i) Provide security during both scheme construction and implementation.
ii) Monitor traffic project flow against the Traffic and Road Safety Act, Cap 361, 1998.
iii) Review the scheme Traffic Management Plan.
iv) Review scheme Security Management Plan.

In line with the World Bank Guideline and Good International Industry Practice (GIIP), the rules of engagement for Uganda Police will align with the following standards:

1. The World Bank requires that any security personnel (including police) involved in Bank-financed projects acts in accordance with applicable laws and international human rights standards.
2. The use of force shall be proportional, only in response to threats, and shall respect human rights norms.
3. Before engaging with police or other security forces, the World Bank requires a thorough risk assessment, particularly for projects operating in fragile, conflict-affected, or high-risk environments.
4. The assessment shall identify potential risks to project staff, local communities, and other stakeholders, and develop appropriate mitigation measures.
5. The World Bank emphasizes the importance of stakeholder engagement and consultations in project planning. This includes ensuring that local communities are aware of and have input into security arrangements, particularly when police or other security forces are involved.
6. Consultations shall be inclusive, gender-sensitive, and accessible to vulnerable groups.
7. The World Bank typically requires that security personnel, including police, receive training on human rights standards and appropriate behavior in dealing with the public.
8. A code of conduct governing interactions with local communities and project stakeholders shall be established, including clear grievance mechanisms.
9. Projects involving security personnel must have accessible, transparent, and effective grievance mechanisms that allow communities and individuals to raise concerns about police conduct.
10. These mechanisms must protect complainants from retaliation and ensure that grievances are addressed promptly and effectively.
11. The World Bank often includes provisions for monitoring the activities of police and security personnel involved in Bank-financed projects. Independent third-party monitoring can be required, especially in high-risk environments.
12. The World Bank's Environmental and Social Framework (ESF) emphasizes compliance with international human rights laws and norms, which also applies to police engagement.
13. Projects shall ensure that any involvement of security forces adheres to international humanitarian law and human rights conventions.

9.3 Contractor Environmental and Social Management and Monitoring Plans

For social and environmental protection and as a measure for impact mitigation and as good practice, projects of such a nature require preparation of plans upon which construction phase will benchmark. The contractor shall develop a skeleton of such plans presented in Appendix L at bidding stage and a full C-ESMP before commencement of any constriction activities.

9.4 Frequency of Monitoring and Reporting

Monitoring will be undertaken throughout the scheme construction period and operational period. Table 9-2 provides an overview of the key logical reports necessary for ensuring effective implementation of this project ESMMP, avoiding doublicative efforts and ensuring that information is shared among all key parties to the project.

Table 9-2 Environmental and Social Monitoring Program

Activity	Monitoring frequency	Responsible entity	Output	Reviewer
Site operation	Daily	Contractor	Daily report	Contractor / SE / MWE
	Weekly	Contractor	Community Outreach report	Contractor / SE / MWE / FTF
			ESHS and Technical report	Contractor / SE / MWE
	Monthly	Contractor	Community Outreach report ESHS and Technical report	SE / MWE / FTF / KDMISTSC
Supervision and management	Daily	Supervising Engineer (SE)	Daily report	MWE
	Weekly	Supervising Engineer	Weekly supervision report	MWE
	Monthly	Supervising Engineer	Monthly supervision report	MWE/WB
		FTF	Monthly supervision report	KDMISTSC
		KDMISTSC	Monthly supervision report	Kanungu District Technical Planning Committee
	Quarterly / Annually	All stakeholders	Minutes and inspection records Quarterly and Annual monitoring reports	Government of Uganda and World Bank

9.5 Environmental and Social Management and Monitoring Plan (ESMMP)

9.5.1 Impacts Management and Enhancement

Table 9-3: Environmental and Social Management Enhancement Matrix for Positive Impact

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
1.	Income to material / equipment suppliers and contractors	Earth materials needed for construction, for example, murram, aggregate (stones and sand) shall be largely obtained from the project affected villages as to attribute to achievement of project local content. However conscious or unwitting purchase of these materials from unlicensed operations would indirectly support, encourage or promote environmental degradation and possibly causing medium- to long-term negative impacts. It will therefore be a contractual obligation for contractors to procure construction materials from sources that are legitimate or licensed by the Authority. The safeguards team shall support the community members in understanding the procedures for the contrators identification and permitting of material sites including MoUs,acquisition of lease agreements,key E&S and statutory requirements.	▪ Local-local content ▪ Adherence to the National Legal framework	▪ Material source contracts within the project area (%) ▪ Material procurement receipts ▪ Material sources ESIS ▪ Material source data sheets	▪ 0 (No contracts yet)	▪ 30%	▪ MWE safeguards team Contractor (Project Manager, Site Engineer, Safety Officer, Sociologists, Environment Officer, Site Nurse, Doctor-On-Call). Engineer (Team Leader, Resident Engineer, Environmental Specialist and Social Development Specialist).	▪ Pre-construction, construction	Before extraction or purchase	Contractor's bid	-
2.	Employment	The contractor is required to draft and submit a Labour Management Plan for approval by the client. A Contractors Labour Management Plan shall be drafted in line with	▪ Improved working conditions	▪ Approved Contractors Labour Management Plan (LMP) ▪ No. of workers	0 0%	100% 60%	▪ Contractor PM	▪ Pre-construction, construction	Before mobilization	Lumpsum	10,000,000

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
		the Labor Act, Employment Act, and OHS Act. The plan will address issues of workers' welfare, child labour, workers code of conduct, sexual harassment among workers, compensation in cases of accidents, payments and contracts, and a grievance management mechanism.		grievances resolved in 14 days ▪ No. of grievances referred	40%	100%					
		All contractors' staff shallbear appointment/ offer letters, contracts and identification tags. This will apply to also subcontractors on the project.	▪ Contractors Identification ▪ Safe working environment ▪ Job security ▪ Safety of contractor ▪ No impersonation	▪ Appointment/ offer letters and contracts ▪ Contactors Identification tags ▪ Contractors branded safety jackets	▪ 0	▪ 100%	▪ Contractors-PM, EHSO	▪ Pre-construction & construction	Before mobilization	1,000 Printing @ 7,000 Id @ Branding @ 5,000 each quarter	25,000,000
		The contractor shall use locally available labour for the unskilled labour requirements and where the required skills are available locally, the local people will be given first priority commensurate to their level of training. This will have the advantage of enabling the local community take responsibility in owning up the project.	▪ Project ownership ▪ Improved project local-local content	▪ No of employed locals ▪ Records of employment	0	30%	PM, LC1	▪ Construction and operation	Monthly	Lumpsum including adverts for available jobs in local areas	18,000,000
		Persons seeking employment will have to be screened, including references from the local Council Chairpersons of their villages of origin before engagement. These shall also present their original National IDs, of which a copy will be kept on file. Also, background checks on all people before employment shall be conducted.	▪ Reduced insecurity cases ▪ Improved project local content	▪ Records of employment	▪ 0	▪ 100%	▪ Contractors - PM, LC1	▪ Construction	Before recruitment	N/A	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
		Monitoring by the LC1 during recruitment will be necessary for transparency.									
		To the extent possible, equal employment opportunity shall be available for women. Fair treatment and non-discrimination among staff shall be effected by the contractor. The construction contractor shall be selective in awarding service contracts, giving preference to women-owned entities. This, for example, is in regard to preparation and supply of foodstuffs to workers on site.	▪ Increased women participation ▪ Project gender sensitiveness	▪ No. of Contracts for women workers ▪	▪ 0	▪ 30%	▪ Contractor - PM, EHSO	▪ Construction and operation	Before mobilization	N/A	N/A
		A training programme for artisans (builders, carpenters, plumbers) in the project area could be facilitated by the project to ensure skills transfer during the construction period.	▪ Knowledge base	▪ No of artisans trained	▪ 0	▪ 70%	▪ Contractors - EHSO		Quarterly	Lumpsum	60,000,000
		The construction contractor will be obligated to work within Uganda's labour laws (*Employment Act*), including restrictions on child labour especially where it can interfere with the child's education.	▪ No child employment ▪ Adherence to Uganda's labour laws	▪ No. of child labour grievances resolved	▪ 0	▪ 100%	▪ Contractor - PM, Sociologist, ESHO	▪ Construction phase	Daily	N/A	N/A
		Adequate occupational health and safety standards shall be provided to ensure the work environment is conducive.	▪ Safe working Environment	▪ Presence of Health and Safety Policy and Standard Operating Procedures	▪ 0	▪ 100%	▪ Contractor - EHSO	▪ Pre-construction and contraction	Before mobilization	Contractor's bid	N/A
		The construction contractor shall be encouraged to pay a all wages to all workers involved in project implementation as per contract terms.	▪ Improved livelihood	▪ No of workers paid per month via the bank /cash	0	100%	▪ Contractor-PM	▪ Pre-construction, construction	Monthly	Contractor's bid	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
3.	Benefit to local retail businesses	During the project progress meetings with local community, the local residents shall be informed about the project and how their businesses can benefit from the project.	▪ Stakeholder collaboration ▪ Project stakeholder ownership ▪ Project knowledge ▪ Understand community expectations ▪ Food consumption health	▪ No. of sensitization meetings conducted. ▪	▪ 0	▪ 6	▪ FTF ▪ Contractor-Sociologist	▪ Construction & Operational phase	Quarterly	Contractor's bid	N/A
		Sensitization of the construction contractor and his staff about public health aspects mainly based on consumption of such food stuffs bought at the construction site from the locals.			▪ 0	▪ 6	▪ Contractors – EHSO		Quarterly	Contractor's bid	N/A
		Use of quality products with standards meeting requirements of the Uganda National Bureau of Standards.	▪ Adherence to standards	▪ % of the products adhering to the standards	▪ 0	▪ 100%	▪ Contractors – EHSO, PM ▪ FTF	▪ Construction and Planting season	N/A	N/A	N/A
4.	Infrastructure Improvement	The extent to which development becomes a positive or negative impact will be determined by the effectiveness of the town planning framework. Such induced developments shall be of a type that is desirable and sustainable and for this to happen, all future developments must be undertaken within the framework of proactive government policy and strict planning and environmental enforcement by the responsible Local Government.	▪ Sustainable development	▪ Percentage of buildings with Approved plans	▪ 0	▪ 100%	▪ Feasibility and ESIA consultant, Contractor, FTF, SE, KDMISTSC & MWE		Quarterly	District budget	N/A
		Integration of sustainable development programs, such as youth empowerment, local road infrastructure linkage, but a few alongside the agricultural command area.		▪ No of scheme integrated sustainable development programs	▪ 0	▪ 100%	▪		Quarterly	District budget	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
5.	Increased Agricultural Activities	The farmers in the command area shall be sensitized about the advantages of chemical fertilizer through exhibitions and these inputs shall be made easily available through co-operative societies/ farmers associations. Liberal supplies of insecticides and pesticides shall be distributed at the cheap rates all over the Kanungu District following Integrated Pest Management Plan.	▪ Farmers knowledgeable on fertilizer application ▪ Adherence to standards	▪ No of farmers involved in irrigated agriculture ▪ No of awareness sessions ▪ Type of fertilizers and pesticides used ▪ Method of application ▪ Competence in application	▪ 0 0	▪ 12900 farmers ▪ 100	▪ FTF	▪ Post Construction	Planting season	MAAIF & District budget	N/A
		Deployment of Integrated Pest Management Plan	▪ Crop pests and diseases control	▪ No of Capacity Building/ Training ▪ Pest and Disease Surveillance ▪ Advisory support given ▪ Deployed livestock pest and disease management ▪ Forms of pesticide waste management	▪ 0	▪ 100	▪ FTF, KDMISTSC & MWE	▪ Post Construction	Annually	MAAIF & District budget	436,000,000
		To save the farmers from the commercial fraudsters, adequate credit facilities shall be made available at reasonable cheap rates in the project area. Credit societies and farmers associations shall be strengthened to provide loans to the cultivators. Moreover, integrated scheme of rural credit shall be implemented.	▪ Access to credit	▪ No of farmers Irrigation associations by enterprise ▪ No and amount of accessed loans by farmers ▪ No of farmers accessing agricultural credit facilities	▪ 0 0 0	▪ 5 63225	▪ FTF, KDMISTSC & MWE	▪ Post Construction	Annually	MAAIF & District budget	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
		Adoption of farm management software, this will help farmers in the command area to take complete control over farming activities and analyze usage of all inputs and expenses, so as to identify weak points and make proper improvements.	▪ Improved IT system ▪ Knowledge base	▪ Percentage of farmers adopting farm management software ▪ Software manuals	▪ 0	▪ 3225	▪ FTF, KDMISTSC, & MWE	▪ Post Construction (Scheme operation)	Monthly	MAAIF & District budget	N/A
		Increased coordination and planning by Kanungu District agricultural officers and Engineers, MAAIF, MWE, but a few concerning agricultural activities in the scheme.	▪ Stakeholder collaboration ▪ Project stakeholder ownership	▪ Presence of minutes of stakeholder engagement meetings ▪ Minutes of progress review meetings ▪ Stakeholder engagement reports					Quarterly	District budget	N/A
6.	Crop diversification	Sensitization of farmers regarding the adoption of pest resilient crops and technology arrangements shall be made for agricultural education and extension services. It would assist the farmers to take proper crop-care leading to increase in crop productivity.	▪ Stakeholder collaboration ▪ Scheme farmer ownership ▪ Safe environment ▪ Technology innovation and knowledge	▪ No of farmers adoptingpest resilient crops and technology arrangement ▪ Community / farmers sensitization meeting records safety.	0	3225			Quarterly	MAAIF & District budget	N/A
		Practice of seasonal soil rotation; it is important to understand how planting recurring crops can affect overall yield. Planting an alternating crop helps to diversify the demands on the soil. This results in crops that not only yield more, but continually produce year in and year out.	▪ Improved produces ▪ Preserved soil fertility	▪ Presence of rotation planting	▪	▪	▪ FTF, KDMISTSC, & MWE	▪ Post Construction (Scheme operation)	Planting season	N/A	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
		Use of high quality and low-cost seed could be the basis for increasing crop yields. Using hybrid seeds that are naturally inclined to grow faster, stronger, and with greater efficiency is pivotal to the success of the scheme.	▪ Improved crop produces ▪ Improved crop breed ▪ Technology innovation and knowledge	▪ No of farmers adopting highbrid seeds.	0	3225			Planting season	N/A	N/A
		Carrying out sound research and development initiatives on resilient crop types.		▪ No of research					Planting season	MAAIF budget	N/A
		Cropping technical assistance, through training on 'non-conventional' farming methods and on innovative ways to share faming knowledge to the command area cultivators.		▪ No of trainings on farming methods	0	6			Planting season	MWE budget	N/A
		The selection of a low volatile or high productive cropping system.		▪ Adopted cropping system					Planting season	N/A	N/A
7.	Expansion of Land under Irrigated Agriculture		▪		▪	▪	▪				
		Ensuring proper water drainage; water management is essential to crop survival and maximizing yield potential. It's important to ensure that the irrigated crops are getting enough water, but also that they aren't being over-watered.	▪ Efficient and effective crop irrigation	▪ Irrigation water coverage (Ha) ▪ Quantity of water usage by the irrigation schemecomp	▪ 0	▪ 9000	▪ FTF, MWE		Planting season	N/A	N/A
		Community sensitization in regards to irrigation technology utilization.	▪ Stakeholder collaboration ▪ Scheme farmer ownership ▪ Technology innovation and knowledge	▪ No of irrigation technology utilization sensitizations heldNo of other scheme supporting government programs ▪ Community / farmers sensitization	0	6	FTF, KDMISTSC & MWE		Quarterly	MWE budget	N/A
		Integration of other government programs related to irrigated agriculture to support the scheme.	▪ Scheme support						Annually	N/A	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
				meeting records							
8.	Improved Food Security and Nutritional Status	Provision of intermediate technological solutions such as light machinery and affordable tools will encourage farmers in the command area to test them. New tools and practices can be better tested to the local conditions through participatory research.	▪ Appropriate tools and technology used	▪ Type and No. of appropriate tools and technology used	▪	▪	▪ FTF, KDMISTSC, MAAIF & MWE	▪ Post Construction (Scheme operation)	N/A	N/A	N/A
		Adoption of policies supporting private and public agricultural input and output, market development, and inducing adoption of more diverse, resilient, and profitable cropping systems.	▪ Better policies	▪ Number of successful harvest seasons. ▪ Yields per season. ▪ Percapital income of farmers.	▪	▪	▪ FTF ▪ MAAIF		N/A	N/A	N/A
		Adoption of crop diversification as a strategy for addressing food and nutritional security.	▪ Improved crop produces ▪ Improved crop breed ▪ Food and nutritional security	▪ Technology of crop diversification adopted ▪ Methods of crop diversification adopted	▪	▪	▪ FTF, KDMISTSC, MAAIF & NARL		Planting season	MAAIF budget	N/A
9.	Improved Land Conditions	Sustainable utilization of fertilizers; cultivating farmland soil with fertilizers is an important part of maintaining optimal soil conditions for crops. Fertilizing the crops at the time of seeding will help provide the seeds with essential nutrients like potassium, phosphorous, and calcium.	▪ Improved produces ▪ Appropriate fertilizer application ▪ Preserved soil fertility	▪ Type of fertilizers applied	▪	▪	▪ FTF		Planting season	MAAIF & District budget	N/A
		Scouting the farmland; this will give the farmers in the command area a chance to assess soil conditions, notice any weeds cropping up, and check if crops are growing healthily.	▪ Improved produces ▪ Preserved soil fertility	▪ No of farm inspections	▪	▪	▪ FTF	▪ Post Construction (Scheme operation)	N/A	N/A	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
		Regular testing of farmland soil quality per cropping season; examining physio-chemical parameters like pH, OM, phosphorus, potassium, CEC, and SAR levels which will give farmers in the command area an insight into how much fertilizer will be needed.		▪ No of soil quality tests	▪	▪	▪ FTF, KDMISTSC		N/A	N/A	N/A
		Weeding early and often; weeds are invasive, and siphon nutrients away from the crops that need to be continuously removed to reduce nutrient competition.		▪ No of weeding times	▪	▪	▪ FTF		N/A	N/A	N/A
		Applying conservation tillage practices as to save time, fuel and machinery wear.		▪ No of times conservation tillage is practiced					N/A	N/A	N/A
		Sensitization of farmers in the command area about the right type of fertilizers available, prices and applications	▪ Knowledgeable on fertilizer application ▪ Adherence to standards	▪ No of awareness sessions ▪ Type of fertilizers and pesticides used ▪ Method of application ▪ Competence in application	▪	▪	▪ FTF	▪ Post Construction (Scheme operation)	Planting season	District budget	N/A
10.	Market Infrastructure	Marketing infrastructure shall be widened and strengthened to help the farmers to sell their products at better prices. There shall be proper arrangements for unloading of the produce in the markets.	▪ Better agricultural marketing platform	▪ No of new road infrastructure ▪ No of new agricultural produce stores ▪ No of new agricultural investors ▪ No of new agricultural signed treaties ▪ No of built or renovated	▪	▪	▪ FTF, KDMISTSC, UNRA, MAAIF		Harvesting season	MAAIF and District budget	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
				marketing infrastructure							
		Price support policy shall be adopted and minimum prices shall be guaranteed to the peasants in the command area.	▪ Sustainable policies	▪ Competitive value of agricultural produces at national and international markets ▪ Tax levied on agricultural produces ▪ No of reviewed policies geared at agricultural price support	▪	▪	▪ Policy makers		N/A	N/A	N/A
		The farmers in the command area shall be supplied with quality inputs at proper times and at controlled prices.	▪ Quality products	▪ Type of agricultural inputs	▪	▪	▪ FTF, KDMISTSC, MAAIF		Harvesting season	MAAIF and District budget	N/A
		Farmers in the command area shall be encouraged to know the yield potential of the farm land, especially understanding the; field's growth potential, kind of crops to plant, and kinds of seeds to use, when assessing yield potential.	▪ Improved technology innovation ▪ Agricultural Knowledge	▪ Methods of planting and application of farm inputs ▪ Kind or type of farm inputs used ▪ No of produces					Planting season	MAAIF and District budget	N/A
		Marketing training of farmer in the command area, with content including; new skills, new techniques and new ways of obtaining information in agriculture		▪ No of trainings conducted and attendance ▪ Training material ▪ No of trained farmers				▪ Post Construction (Scheme operation)	Quarterly	MAAIF and District budget	N/A
11.	Enhanced values of the agricultural produce	To check the sub-division and fragmentation of holding, the movement of co-operative farming shall be launched. Co-operative farming would result in the adoption of modern technology on	▪ Large scale farming	▪ No of large-scale farms ▪ No of co-operative farming groups	▪	▪	▪ FTF		N/A	N/A	N/A

No	E&S anticipated Positive Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
		so-called big farms. In this way, agriculture in the command area will become profitable occupation through economies of large-scale farming.									
		Planting early and effectively through choosing the right time to plant will be the best strategy to use. Planting early will result in increased yields by taking advantage of unexpectedly early favorable soil conditions.	▪ Improved produces	▪ Planting schedules ▪ Seasonal planting					N/A	N/A	N/A
		More emphasis shall be made to set up cottage and small scale agro-produce industries. This will raise the income of the peasants and keep them busy during the off season.	▪ Agro-industries	▪ No of agro-produce industries	▪	▪	▪ FTF, KDMISTSC, Private investors		N/A	N/A	N/A
13	Dam filling	Monitor the colonization and changes in assemblage of aquatic and terrestrial life forms as the dam fills so as to possibly weed out an unwanted invasive life forms such as water hyacinth. This shall include regular evaluation of the changing ecological effects.	▪ No Invasive life form	▪ Presence of invasive life form	▪	▪	▪ MWE		Weekly	MAAIF and MWE budget	N/A
		Facilitate movement and colonization of the filling reservoir with naturally suitable life forms, such as sedentary deep water loving forms.	▪ No impended aquatic life movement	▪ No of trapped aquatic life	▪	▪	▪ MWE		Weekly	MAAIF and MWE budget	N/A
		Implement a monitoring plan to study the changes in hydraulic and hydrological parameters of the stream, and how the changes are impacting on productivity of the waters.	▪ Improved water quality	▪ Water quality	▪	▪	▪ MWE		Quarterly	MAAIF and MWE budget	N/A

No	E&S anticipated <u>Positive</u> Impact	Proposed Enhancement Measures	Desired outcome	Performance Indicators (Means of verification)	Baseline	Target	Responsibility	Implementation time	Duration	Cost Description (all costs in UGX)	Impact management cost
		Proper dam management will ensure structural integrity and a reliable water supply for irrigation, which can enhance agricultural productivity.	▪ Sound dam infrastructure	▪ No of monitoring and surveillance reports	▪	▪	▪ MWE		Monthly	MWE Budget	N/A
Management Enhancement for Positive Impact Total										**5,049,000,000**	

Table 9-4: Environmental and Social Management Matrix for Negative Impact

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
X							X							Enforce restrictions on unnecessary entry into the construction working area. Managing site access by defining site boundaries clearly and physically to prevent the community from entering the site and prevent particular objects from escaping. In other words, hording/fencing off the construction site.	Improved security Public safety	Presence of a fence Contractors' security plan	Contractor: PM, PE, EHSO	Pre-construction, construction and operation	Daily	Contractor's bid	110,000,000
X	X	X	X	X	X	X	X		X		X	X	X	Conduct awareness campaigns/ sensitization in schools and project communities about the risks of students/locals coming close to the construction site.	Stakeholder collaboration Project stakeholder ownership Safe environment Project safety knowledge No or reduced incidents	Community sensitization meeting records safety. No of recorded incidents Incident reports	Contractors: EHSO DCDO	Construction & Operational phase	Monthly	Lumpsum; 2.5 m @ month	150,000,000
X		X			X		X					X		Safe vehicle speed limits shall be instituted and enforced at site including vehicle manuvours around the site	No accidents Reduced dust generation Adherence to the Traffic and Road Act	Vehicle movement Log Vehicle Inspection Checklist No of community and workers grievances related with traffic issues or vehicles in use	Contractor: EHSO, Drivers	Pre-construction, construction and operation	Daily	Contractor's bid	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
																No of accident incidents No of wildlife-vehicle collisions Presence of a speed governor Traffic Management Plan					
X		X			X		X							Deployment of a contractors Traffic Management Plan (TMP) to reduce project traffic related community accidents	Safe and efficient traffic management No of related traffic incidents	Approved contractors Traffic Management Plan Traffic police engagement records No of related community grievances No of traffic related Incidences	Contractor: EHSO	Pre-construction & construction	Before mobilization	Lumpsum	10,000,000
X							X		X					Empowering of scheme beneficiaries (farmers in the command area) on guarding public safety for the installed network, mainly the Farmers Task Force (FTF)	No of scheme related public safety incidents	No of incidents No of community grievances related to scheme public safety	FTF	Scheme operation	Monthly	Lumpsum; 15 m @ month for community sensitization	900,000,000
X							X							The contractor will bear the full accountability of creation of a safe environment for both the project workers and the community at large. The contractor's management shall give priority to Health, Security, Safety and Environment. The contractor's management shall ensure that all employees,	Safe working environment Adherence to the legal requirements and contractual obligations	No of incidents Hired NEMA certified EHS experts Presence of approved safety plans Presence of ESHS records	Contractors: PM	Pre-construction and construction	Daily	Contractor's bid	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														including subcontractors are aware of their personal responsibilities in maintaining an accident free and healthy work environment.							
	X		X	X								X		All construction equipment shall be kept in good operating condition to avoid oil or fuel leakages that might contaminate water resources. Poorly maintained machinery shall not be allowed to operate on site. All routine maintenance of construction machinery and vehicles shall be carried out in a designated workshop / maintenance area with concrete hard standing surface and drainage to an oil interceptor.	Safe working environment Pollution control	Vehicle movement log book Vehicle inspection check list Equipment and machinery service records Equipment and machinery operators training records Procurement of replacement parts, material records No of related community grievance	Contractors: PM, PE, EHSO FTF	Pre-construction, construction Scheme operation	Daily Daily	N/A N/A	N/A N/A
	X											X		Water quality of the source (at construction site) shall be monitored on a monthly basis, with samples taken and analysed for all forms of contaminants to benchmark them to baseline results in Table 5-10	No water contamination	Community grievances related to water quality Water monitoring records	Contractors: PE, EHSO	Construction	Monthly	Lumpsum; 2.2 m @ month for water tests	132,000,000
	X				X							X		Any hazardous wastes including material soiled with hazardous wastes and empty containers of hazardous materials shall be stored in a	Proper waste storage Adherence to National legal framework	Hazardous wastes site storage, transportation, disposal records	Contractors: EHSO	Pre-construction, construction	Monthly	Lumpsum	275,000,000

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														designated area on site for regular removal and disposal by a registered contractor. All other wastes generated during site preparation and construction shall be transported by the contractor or a company that has been specifically contracted to an authorized disposal area.		Hazardous wastes data sheets Quantity of hazardous waste generated Approved waste management plan					
	X											X		Fuel handling and oil spill measures shall be implemented to prevent, control and address spill or leaks. Fuel and oil handling shall be assigned to trained personnel and done at designated places at the contractor's camp in accordance to relevant standards set by the Energy Regulation Board and Uganda Bureau of Standards.	Proper waste storage No spills and contaminations	Oil waste safety handling procedure Oil waste storage, transportation, disposal records Records of oil spillage Oil and Chemical Spillage plan					
								X						Implementation of dam safety and emergency response [lans to mitigate risks associated with seismology, dam failure and other incidents.	Public safety	Dam safety management plan in place Routine dam inspection reports	MWE		Quarterly	1.5m@Quarter	300,000,000
	X	X												Continuous monitoring of air quality against regulated emissions, such as draft NEMA's air quality standards in the construction phase. Benchmark on Table 5-3	No dust generation Adherence to draft NEMA's air quality standards	Community grievances related to dust generation/ air pollution Air quality monitoring records	Contractors: PE, EHSO		Monthly	Lumpsum; 1.5 m @ month for water tests	90,000,000

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
	X	X		X								X		Use of fertilizers and pesticides meeting required standards, such as International Code of Conduct on Pesticide Management in adherence to the national Control of Agricultural Chemicals Act, 2010 following the integrated pest management practices.	Adherence to Integrated pest management practice standards	Type of fertilizers and pesticides used. Method of application. Competence in application.	FTF	Planting season	N/A	N/A	N/A
X	X			X								X	X	Deployment of a contractors Soil Erosion Control Management Plan (SECMP) and Spill Management Plan (SMP) to alleviate water pollution impacts	No or reduced soil erosion No or reduced spillage No or reduced water pollution	Records of spillage incidents Approved SECMP and SMP	Contractors: EHSO	Pre-construction, construction	Before mobilization	Lumpsum	10,000,000
	X											X		The designation of flood plains can also be a useful measure that allows groundwater recharge in the command area and reduces peak discharges downstream.	No flooding	Fish fecundity Number of breeding sites compared to the baseline. Macro inverterbrate survivals Water flow rate Volume of water released per hour	Design Engineer	Pre-construction	N/A	N/A	N/A
	X											X		The project shall acquire water abstraction permits with conditions to guide the amount of water to be abstracted as stipulated in the Water Supply Regulations (1999). Water abstraction will comply with rates allowed by the DWRM permit that will be obtained.	Adherence to National legal framework No or reduced water pollution	Presence of water abstraction permits Renewal evidence receipts for water abstraction permits	MWE-WfP	Pre-construction, construction	Annually	Permit fees estimated at 2,000,000	10,000,000

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
		X												Select low emission equipment and those with low fuel consumption as much as practicable	No or reduced pollution	Equipment engine specifications Equipment inspection Quantity of consumed fuel	Contractors: PE, EHSO		Before mobilization	Contractor's bid	N/A
X		X	X											Shut down equipment when not in use to minimize idle time.	Reduced air quality impact Reduced noise impact	No of related community grievances Observed shut down equipment	Contractors: PE, EHSO, equipment operators	Continuous during pre-construction and construction once the equipment is not in use	Daily	N/A	N/A
X		X	X											As far as possible, source material from locations close to the construction sites to reduce haulage distances;	Reduced project impact exposure to numerous receptors Reduced environmental degradation	Distance of material source sites	Contractors: PM, PE, EHSO	On acquisition of material source sites/materials	Before extraction or purchase	Contractor's bid	N/A
		X				X								No open burning of waste practice shall be adopted.	No air pollution Better waste management practices	Records of Waste disposal and methods Approved WMP Community sensitization meeting records about open burning of waste practice	Contractor: EHSO	Construction/ Daily	Daily	N/A	N/A
X	X	X					X					X	X	Reduced or no use of chemical pesticides/fertilizers through manual weed removal, placing traps and lures, removing pest breeding sites, growing more resistant plants, cropping native species that are naturally more	No or reduced pollution	Record/log of fertilizers and pesticides used Method of application Competence in application	FTF	Planting season during operation	Daily	N/A	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														resistant to native pests and supporting biocontrol agents such as birds and other pest predators. Use of sustainable fertilizers and pesticides. Proper application of sustainable fertilizers and pesticides, through following labelled directions, monitoring the weather when applying pesticides (avoid very hot or windy days).		No of times when chemical vs. natural fertilizers and pesticides are used					
X		X											X	Covering of trucks delivering materials with tarpaulin to reduce the risk of fugitive dust emissions, especially in busy trading centres; to minimize exposure to agents of erosion such as wind and running water.	No or reduced air quality pollution No spillage	Community grievance Material source logs Truck inspection logs	Contractor: EHSO	Construction	Daily	N/A	N/A
		X		X								X		Limited vegetation clearing to the minimum shall be required for safe construction to minimise exposed areas and vegetation removal;	Reduced flora impact	Volumes of cleared sites No of community grievances concerning damage of crops and trees	LT, PE, Foremen, EHSO	Construction phase	Daily	N/A	N/A
X		X	X		X		X							Drivers shall be sensitized, emphasising the need to stick to designated routes and speed limits.	No accidents Adherence to the Traffic and Road Act and the Traffic Management Plan	Vehicle movement Log No of driver training records No of related community and workers' grievances No of accident incidents	Contractor: EHSO, Drivers	Pre-construction, construction and operation	Quarterly	Lumpsum; 8 m @ staff sensitizations	120,000,000

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
																Presence of a speed governor Traffic Management Plan					
X		X			X		X							Optimize the logistics to maximize use of available vehicles, and therefore reduce number of trips	Reduced project impact exposure to numerous receptors No of related incidents Reduced environmental degradation	Journey management plans (JMP)	Contractors,Planning department	Construction phase	During mobilization	Contractor's bid	N/A
X		X												Local weather stations often shall post local air quality information and weather forecast for the sub-counties.	Weather Knowledge	No of weather Programs on local communication networks	Kanungu District	Operational	Weekly	MWE budget	N/A
X	X	X					X					X		Deployment of a contractors Dust Management Plan (DMP) and Spill Management Plan (SMP) to alleviate air pollution impacts	No or reduced air pollution Adherence to the national draft air quality regulations	Approved DMP	Contractors: EHSO	Pre-construction, construction	Before mobilization	Lumpsum, 10 m @ plan	20,000,000
X		X	X		X		X		X					Construction activities shall be limited to daytime	Reduced receptor exposure Safe working environment	No of related community and work force grievances Working logs	Contractors: EHSO, Foremen, PE	Construction phase	Daily	N/A	N/A
X			X				X							The contractors on site shall be made aware of, and adhere to, the regulatory noise limits for a construction site in a commercial area (75 dBA) and that in a residential area (60 dBA) as provided for by the National Environment (Noise Standards & Control)	No or reduced noise generation Adherence to draft NEMA's Noise Standards & Control Regulations	Community grievances related to noise pollution Noise monitoring records	Contractors: PE, EHSO	Monthly	Daily	N/A	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														Regulations, 2003; and benchmark to them Table 5-4							
X			X											Deployment of a contractors Noise Management Plan (NMP) to alleviate noise pollution impacts		Approved NMP	Contractors: EHSO	Pre-construction, construction	Before mobilization	Lumpsum	10,000,000
				X		X						X		Topsoil and subsoil removed from the site during site preparation shall be stored properly (away from runoff and possible contaminants) for reuse elsewhere or for backfilling and reinstatement	No or reduced soil erosion	Volume of excavation Soil storage methodology Presence of SECMP	Contractors: PE, EHSO	Construction	Daily	N/A	N/A
X				X							X			During reinstatement, the trench back-fill material shall be compacted to a level similar to the original surrounding soils to avoid subsidence as a consequence of rainwater channelling.	Safe environment No or reduced soil erosion	Reinstated trench back-fill material, compacted to a level similar to the original surrounding soils			Daily	N/A	N/A
X				X		X								All waste generated during site preparation and construction shall be transported to an authorized disposal area. The contractor will seek guidance from the Kanungu District Local Government of the respective	Proper waste storage Adherence to National legal framework	Wastes site storage, transportation, disposal records Wastes data sheets Quantity of waste generated Approved WMP	Contractors: EHSO	Pre-construction, construction	Weekly	Included in waste management costs	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														project areas on the final disposal point.							
	X	X		X		X	X							A Spill kit shall be maintained onsite to clean-up any accidental spills.	No or reduced spill related pollution No spillage	No of related community grievance Spill incident records Equipment inspection logs	Contractor: EHSO	Construction/ whenever there is a spill		Lumpsum	35,000,000
	X			X								X		Retention ditch shall be provided such that runoff from the project site does not go directly into neighbouring gardens or drain into the underground source.	Safe environment No or reduced soil erosion	Reinstated trench back-fill material, compacted to a level similar to the original surrounding soils	Contractor: EHSO, PE	Construction		Contractor's bid	N/A
	X			X		X						X		A Waste Management Plan (WMP) will be developed prior to start of construction activities and implemented thereafter.	Proper waste management Reduced waste generated Adherence to the National waste management regulations	Approved WMP	Contractors: EHSO	Pre-construction, construction	Before mobilization	Lumpsum	10,000,000
	X			X								X		Continuous monitoring of soil quality against regulated emissions (see Appendix I)	No soil pollution	No of soil tests No of spills	Contractors: EHSO	Construction		Contractor's bid	N/A
					X		X		X					All construction workers will be sensitized about responsible sexual behaviour with the communities.	No SEA/SH cases Reduced spread of HIV Sexual rights awareness	HIV & sexual rights community and workers sensitization records HIV/AIDS perseverance levels	Contractors: Sociologist, EHSO	Construction	Quarterly	Included in staff sensitization lumpsum cost	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
																No of related community/workers grievances Number of HIV & sexual rights signage on sites and schools (provided by the project)					
X					X				X					Workers prohibited from interaction with the school students.	No defilement No SEA/SH cases	HIV & sexual rights school and workers sensitization records HIV/AIDS perseverance levels No of related school/workers grievances No of Violence Against Children (VAC) cases Number of HIV & sexual rights signage on sites and schools	Contractors: Sociologist, EHSO	Construction	Monthly	N/A	N/A
X					X		X		X					The contractor shall follow up any grievances from the community and the schools (Table 5-26).	Operational and efficient communication with affected and interested stakeholders	No of recorded verse handled grievances Average number of days to resolve grievances	Contractors: Sociologist, EHSO	Construction	Monthly	Lumpsum	250,000,000
					X		X		X					Conduct background checks on all people before employment	Reduced insecurity cases Project ownership	Records of employment	Contractors: PM, LC1	Construction and operation	Before recruitment	Contractor's bid	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
															Improved project local content						
X					X		X							Hire security guards from a registered company that have records of each guard, to protect both the contractor and the project site	Safe working environment Equipment and material security	Contracts with security guard company Site inception rounds by the security guard Log Receipts of payment of security company	Contractors: PM, EHSO	Pre-construction, construction	Before mobilization	Contractor's bid	N/A
X					X		X		X					Collaborate with the local administration including; LC1s, police post and Kanungu District police station.		MOU with area local police Site inception rounds by the LC defense	Contractors: PM, LC defense	Pre-construction, construction		Contractor's bid	N/A
X					X		X							"No Trespassing" signs will be prominently displayed on fencing or the perimeter of the job site. Such signs will discourage unauthorized intrusion onto the job site and if correctly worded aids in the prosecution of apprehended trespassers.	Safe working environment Keeping away intruders Security	Well labeled, clear and visible warning signage Warning signs procurement records Sensitization records of the community and workers about the warning signage	Contractor: EHSO & Sociologist	Construction phase	After fence construction	Signage lumpusm	25,000,000
X					X		X		X					Deployment of contractor's code of conduct	Preserved ethical standards	Contractors ethical code of conduct No of relevant workers grievances No of relevant community grievances	Contractor: PM	Pre-construction, construction	N/A	N/A	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
X					X	X	X		X					The contractors on site shall be made aware of, and adhere to community and Kanungu District bylaws, national legal framework on social and health conduct.	Respect of community bylaws	Local community administration. Grievance Redress Management Committee No of workers cases at the police or defense	Contractor: PM, Sociologist, ESHO	Construction phase	N/A	N/A	N/A
X					X		X		X					Deployment of a contractors Labour Management Plan (RLP), Cultural Plan, and Gender Mainstreaming Plan, HIV/AIDS Plan, Community Liaison / Engagement Plan, and Grievance Management Plan to alleviate impact of social misdemeanour.	Improved working conditions	Contractors Labour Management Plan (RLP No of workers grievances	Contractor: PM	Pre-construction, construction and operation	Before mobilization	Lumpsum 10 m @ plan	40,000,000
X	X	X	X	X	X	X	X		X					Construction workers shall be provided with appropriate protective gear. The project contractors and sub-contractors shall be required to provide appropriate PPE for their workers to ensure that any risks are minimized to a level that is as low as reasonably practicable. Appropriate PPE shall be used by the construction workers to minimize the severity of accidents on site, if they occurred	Safe working Environment Safety Knowledge	PPE procurement records Records for acquisition of PPE PPE worn at site during works Records of PPE induction meetings	Contractors: EHSO and Procurement officer	Construction	Quarterly	Lumpsum	600,000,000
						X	X							Provide an area within the construction site to allow for	Proper waste management	Approved waste storage designated area	Contractors: EHSO	Construction	e Quarterly	Lumpsum	250,000

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														sorting and segregation of materials		Good housekeeping at the storage area Quantity of stored waste					
		X				X	X							Using dust suppression techniques (such as dampening with fine water spray and covering with tarpaulin)	No or reduced dust pollution	Water quality abstracted No of times water is sprayed	Contractors: EHSO	Construction	Daily	Lumpsum	216,000,000
						X								Continuous monitoring and annual Environmental and Social Audits of contractor's waste management practises against National Environment (Waste Management) Regulations, 1999 and the World Bank E&S safeguards in the construction phase.	Proper waste management	Waste records No of Environmental and Social Audits Relevant results of the Environmental and Social Audits	ESAE Contractors: EHSO	Construction	Annually	Lumpsum	400,000,000
X					X		X							All project workers shall have to bear a project identification	Contractors Identification Safe working environment Safety of contractor No impersonation	Contactors Identification tags Contractors branded safety jackets	Contractors: PM, EHSO	Pre-construction & construction	At recruitment	Cost included in recruitment costs	N/A
X					X		X							All workers shall undergo an induction before commencement. It will also be through inductions that the contractor will ensure that all workers are conversant with resource conservation practices in all project activities.	Safe working environment Safety Knowledge	ESHS Induction material ESHS Induction attendance records	Contractors: PM, EHSO, Sociologist		Before mobilization	Contractor's bid	N/A
							X							Toolbox meetings at construction site sections on		Daily toolbox meetings records	Contractors: EHSO	Construction	Daily	Contractor's bid	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														safe work practices shall be conducted daily.							
							X							Safety training shall be conducted routinely on how to prevent and manage incidences on site.		Safety and health training material Safety and health training attendance records	Contractors: EHSO	Construction	Quarterly	Cost included in staff training and sensitization costs	N/A
X							X							Providing of First Aid units fully equipped with the necessary materials at the dam site, command area and camp site and, train first aiders to administer it.	Efficient First Aiding Reactive response	First aid facilities Procurement of first aid equipment and material records First aid facilities usage records No of first aid incidences	Contractors: EHSO	Pre-construction, construction	Monthly	0.8 m @ month Lumpsum	48,000,000
							X							Personnel shall only undertake tasks for which they are trained/ qualified. A formal 'permit to work' system shall be in place and strict instructions shall be given for operators of equipment.	Safe working environment Safety Knowledge	NNumber of Qualificatinos Number of work permits issued	Contractors: PE, EHSO, Foremen	Construction	Daily	Contractor's bid	N/A
							X							Supervision of works shall be done regularly to ensure that safety conditions are met while any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work.	Safe working environment	Number of personnel engaged in tasks with no required training Number of work permits issued	Contractors: EHSO	Daily during construction and weekly during operation	Daily	Contractor's bid	N/A
X							X							Clear communication line shall be ensured between workers and operators/drivers of heavy equipment.	Safe working environment	Approved CMP Well elaborated communication strategy	Contractors	Construction	Daily	Lumpsum for walkie-talkies	20,000,000

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																Evidence of communication responses					
X							X							A qualified Health and Safety Officer shall be recruited by the contractor to oversee OHS matters on a daily basis and project safety committees shall be constituted		Environmental Engineering or related qualifications OHS professional related qualifications NEMA certified environmental practitioner certificate Contract of qualified ESH	Contractor: PM, EHSO	Pre-construction & construction	Before mobilization	Contractor's bid	N/A
X							X							A workplace registration license shall be obtained from Ministry of Gender Labour and Social Development (Department of OHS).	Safe working environment Adherence to ESHS Act, 2006	Workplace registration license	Contractor: PM, EHSO	Construction	Annually	Lumpsum; acquisition and renewal fees	15,000,000
							X							The contractor shall bear and implement a Health and Safety Policy and Standard Operating Procedures that will be explained during induction; Continuous monitoring, Job Hazard Analysis, regular OHS Audits against OHS legal framework, such as; Occupational Health and Safety Act 2006, Employment Act 2006, Public Health Act Cap 281, Workers Compensation Act 2006, National Environment	Safe working evironment	Presence of Health and Safety Policy and Standard Operating Procedures	Contractor: EHSO	Pre-construction	Before mobilization	Contractor's bid	N/A

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														(Control of Smoking in Public Places) Regulations 2004, Traffic and road safety act, 1998, but a few in the construction phase.							
							X							The contractor's management shall ensure that safe working methods are adopted for hazardous operations.		Application of safeguards for all deployed methods	Contractor: EHSO	Pre-construction & construction	Daily	Contractor's bid	N/A
X							X							Deployment of a contractors Environment Social, Health and Safety Plan (ESHSP) and Emergency Response and Incident Management Plan (ERIMP) to alleviate safety risks		Approved ESHSP and ERIMP	Contractor: EHSO	Pre-construction	Before mobilization	Lumpsum, 10 m @ plan	20,000,000
X					X		X							Deployment of project Grievance Management Plan (GMP) as to capture and handle worker safety reported risks and public safety related risks	No ofgrievances Improved working relationship Safe working environment	No of worker grievances recorded Approved GMP Register of reported abuse cases against contracted women if any and actions taken	Contractor: PM, Sociologist, EHSO	Pre-construction & construction	Before mobilization	Has been included in grievance management	N/A
X							X		X					The contractor shall use gender-sensitive language such as: "Go Slow, Work in Progress" instead of "Go Slow, Men at Work". This, coupled with women's visibility in construction works would, contribute to women's empowerment as well as breaking the stereotype that	Women's empowerment	No of signage and type of massage	Contractor: PM, EHSO	Construction		Cost included in Lumpsum of signage	N/A

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														construction is a preserve of men.							
X									X					The contractor shall sensitise project workers about gender discrimination and sexual harassment.	Increased women participation Project gender sensitiveness	Approved RLP. Workers code of conduct Contracts for workers No of related grievances from women	LT-PM, EHSO	Construction and operation	Monthly	Cost included in Lumpsum of Staff sensitization	N/A
									X					Contractor shall be encouraged to pay an equal 'living wage' to all workers involved in project implementation including women on the same job posts as men.	Improved livelihood and gender equity	Labour contracts and payment statements No of related worker grievances	LT-PM	Pre-construction, construction	Monthly	Contractor's bid	N/A
X							X		X					The contractors on site shall be made aware of, and adhere to community and Kanungu District bylaws, national legal framework guiding women inclusion and their rights protection, such as; Occupational Health and Safety Act 2006, Employment Act 2006, Public Health Act Cap 281, Workers Compensation Act 2006, but a few in the construction phase.	Gender inclusion	Presence of GMP	Contractor: EHSO	Pre-construction	Monthly	Cost included in Lumpsum of Staff sensitization	N/A
X							X							Implementation of a Contractors Violence Against Children prevention and response plan.	No VAC	Contractors Violence Against Children Prevention and Response Plan	Contractor: PM, Sociologist, EHSO	Construction	Before mobilization	Lumpsum	10,000,000

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
X							X							Continuous engagement with the stakeholders, including sensitization of the community about Violence Against Children (VAC)	Stakeholder collaboration Project stakeholder ownership VAC awareness No VAC incidences	VAC community sensitization records No of VAC grievances Contractors Community Engagement plan Contractors Violence Against Children Prevention and Response Plan	Contractor: Sociologist	Construction	Monthly	Cost included in Lumpsum of community sensitization	N/A
											X			Sensitization of community members whose property shall be affected.	Reduced impact on livelihood Reduced disruption of community activities	Community sensitization records No of community engagements Compensation of PAPs No of community grievances	RAP Consultant	Pre-Construction	Monthly	Cost included in Lumpsum of community sensitization	N/A
											X			Completion of a full inventory of privately registered and cultivated or grazed or under other uses of the property that will be taken for the project as well as structures and graves within the scheme.			Site in charge		Monthly	Contractor's bid	N/A
											X			Compensation to be paid in line with mandated rates agreed in consultation with the respective Project District Officials' before commencement of construction activities.			MWE		Once	Cost included in Valuation Report	N/A
											X			Ensuring that the Chief Government Valuer approves the valuation rates			RAP Consultant, MWE, Kanungu District		Once	Cost included in RAP Report	N/A
											X			Adhering to both National legal framework, such as; Constitution of the Republic of					Daily	N/A	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														Uganda, 1995; National Land Policy, 2013; National Irrigation Policy, 2017; National Agricultural Policy, 2013; Land Act, Cap 227, 1998; Local Governments Act Cap 243, 1997 and World Bank operational safeguard requirements specifically OP 4.12 Involuntary Resettlement.							
X					X						X			Continuous engagement with all project stakeholders, especially the local administration leaders (Table 5-22) and the community for project ownership. This shall include continuous project progress feedback/ reporting.			Contractor: PM, Sociologist, ESHO		Monthly	Cost included in Lumpsum of community engagement	N/A
											X			Deployment of project Grievance Management Plan (GMP) as to capture and handle any land related grievances in relation to the project.			Contractor: PM, Sociologist		Monthly	Cost included in grievance management	N/A
	X											X		Adoption of environmental flow of 0.64 m^3/s for low flow regimes and a one in two-year flood of 13m^3/s of R. Kirurum	Preservation of downstream ecology (Appendix E)	Ecological monitoring report	Designer/Engineer	Pre-Construction & Construction phase	Design	N/A	N/A
												X		An eco-friendly design shall be used to promote a green environment around the facility	Conserved Eco-system				Design	N/A	N/A
												X		Restriction of equipment to the project footprint and designated areas; Movement of crews and equipment within the right of way and through routes	No wetland encroachent Reduced flora impact	Volumes of cleared sites No of community grievances	Contractor: PM, ESHO		Daily	Contractor's bid	N/A

Impact on Public Safety	Impact on Local Area Water Hydrology	Air Pollution	Noise Pollution	Degradation of Soils and Soil Erosion	Social Misdemeanour by Workers	Waste Generation	Occupational Health and Safety	Dam Safety	Impact on Gender	Impact on Vulnerable Farmers and VMG's	Land Take	Impact on Project Area Ecology	Unsustainable Use of Resources	**Proposed Mitigation Measures**	**Desired Outcome**	**Performance Indicators (Means of Verification)**	**Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Management Cost**
														provided for access to the work site, shall be performed in a manner to prevent damage to crops or property		concerning damage of crops and trees					
				X								X		A restoration plan for the opened-up areas shall be drawn and followed to ensure re-establishment of the original vegetation. Deployment of decommissioning plan and restoration plans for all sites to alleviate biodiversity loss.	Full restoration	Approved restoration plan			At decommissioning	Lumpsum	10,000,000
												X		Installation of an electric fence along the park and project area. Prior to its installation, meaningful consultations with UWA and standalone ESIA shall be conducted.	Less or no wildlife-human conflict	Minutes of consultation with UWA Approved ESIA report and NEMA certificate	UWA	Pre-Construction	Once		Cost to be borne by UWA
										X				Sensitization and awareness on project activities, land use rights and project benefits	Empowered community with project information	No of sensitization meetings on land use rights and project benefits	MWE/ MAAIF	Pre-Construction, Construction & operation phases	quarterly	Quarterly engagement meetings	2,000,000
		Management for Negative Impact TOTAL																		**3,726,250,000**	
		TOTAL MANAGEMENT COST FOR IMPACTS IS 4,475,250,000																			

9.5.2 Impacts Monitoring and Enhancement

Table 9-4: Environmental and Social Monitoring Matrix for Positive Impact

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
1.	Income to material / equipment suppliers and contractors	Earth materials needed for construction, for example, murram, aggregate (stones and sand) shall be largely obtained from the project affected villages as to attribute to achievement of project local content. However conscious or unwitting purchase of these materials from unlicensed operations would indirectly support, encourage or promote environmental degradation and possibly causing medium- to long-term negative impacts. It will therefore be a contractual obligation for contractors to procure construction materials from sources that are legitimate or licensed by the Authority.	▪ Stakeholder meetings/ consultations ▪ Progress review meetings	Record of payments for material and equipment. Physical observation of material supplies at the site. Record of engagements with suppliers e.g local purchase order.	▪ Daily by contractor ▪ Monthly by SE & FTF ▪ Quarterly by KDMISTSC & MWE	▪ Pre-construction, construction	▪ During extraction or purchase	▪ N/A	▪ N/A
2.	Employment	The contractor is required to draft and	▪ Review of	▪ Appointment	▪ Daily by	▪ Pre-construction,	▪ Quarterly	▪ 47.2 m @ Quarterly	▪ 708,000,000

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		submit a Labour Management Plan for approval by the client. A Contractors Labour Management Plan shall be drafted in line with the Labor Act, Employment Act, and OHS Act. The plan will address issues of workers' welfare, child labour, workers code of conduct, sexual harassment among workers, compensation in cases of accidents, payments and contracts, and a grievance management.	RLP	letters. ▪ Record of appraisals ▪ Toolbox meeting records. ▪ Staff meeting records. ▪ Recruitment plan.	contractor ▪ Once at start of project by SE, KDMISTSC & MWE	construction		meeting, including site visit	
		All contractors' staff shall bear appointment/ offer letters, contracts and identification tags. This will apply to also subcontractors on the project.	▪ Review of contractor's contractual obligations ▪ Site inspection	▪ Availability of HR files. ▪ Availability of inspection reports	▪ Daily by contractor ▪ Monthly by SE & FTF ▪ Quarterly by KDMISTSC & MWE	▪ Pre-construction & construction	▪ Quarterly	Imbedded in cost of quarterly review meeting cost	▪ N/A
		The contractor shall use locally available labour for the unskilled labour requirements and where the required skills are available locally, the local people will be given first priority	▪ Validation of Contractors workers appointment letters and contracts ▪ Community Engagements	▪ Contractors' workers appointment letters and contracts	▪ Quarterly by SE, FTF, KDMISTSC, police & MWE	▪ Construction and operation	▪ Quarterly	▪ Imbedded in cost of quarterly review meeting cost	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		commensurate to their level of training. This will have the advantage of enabling the local community take responsibility in owning up the project.							
		Persons seeking employment will have to be screened, including references from the local Council Chairpersons of their villages of origin before engagement. These shall also present their original National IDs, of which a copy will be kept on file. Also, background checks on all people before employment shall be conducted. Monitoring by the LC1 during recruitment will be necessary for transparency.				Construction	Monthly review meeting	15.7 m @ monthly meeting, including site visit	942,000,000
		To the extent possible, equal employment opportunity shall be available for women. Fair treatment and non-discrimination among staff shall be effected by the	▪ Validation of Contractors workers appointment letters and contracts	▪ Number of gender grievances	▪ Quarterly by SE, KDMISTSC & MWE	▪ Construction and operation	▪ Quarterly	▪ Imbedded in cost of quarterly review meeting cost	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		contractor. The construction contractor shall be selective in awarding service contracts, giving preference to women-owned entities. This, for example, is in regard to preparation and supply of foodstuffs to workers on site							
		A training programme for artisans (builders, carpenters, plumbers) in the project area could be facilitated by the project to ensure skills transfer during the construction period.	▪ Review of training material and records of attendance ▪ Workers practice inspection ▪ Community grievances	▪ Competence of workers		▪ Monthly	▪ Quarterly	▪ Imbedded in cost of quarterly review meeting cost	▪ N/A
		The construction contractor will be obligated to work within Uganda's labour laws (*Employment Act*), including restrictions on child labour especially where it can interfere with the child's education.	▪ Site visits ▪ Stakeholder engement consultations	▪ Minutes of progress review meetings ▪ Community and workers grievances records	▪ Monthly by contractor, SE ▪ Quarterly by KDMISTSC & MWE	▪ Construction phase	▪ N/A	▪ N/A	▪ N/A
		Adequate occupational health and safety standards shall be provided and implemented to	▪ Review of Contractors Health and Safety Policy and Action	▪ Comments from the review ▪ Minutes of	▪ Monthly by contractor ▪ Quarterly by	▪ Pre-construction and contraction	▪ Monthly	▪ Imbedded in cost of Monthly review meeting	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		ensure the work environment is conducive.	Plan	progress review meetings	SE ▪ Pre-construction by MWE (Once)			cost	
		The construction contractor shall be encouraged to pay a 'living wage' to all workers involved in project implementation.	▪ Validation of Contractors workers appointment letters and contracts ▪ Consultation of workers	▪ Records of worker payments ▪ Minutes of progress review meetings	▪ Daily by contractor ▪ Quarterly by SE ▪ Pre-construction by MWE (Once)	▪ Pre-construction, construction	▪ Monthly	▪ Imbedded in cost of Monthly review meeting cost	▪ N/A
3.	Benefit to local retail businesses	During the project progress meetings with local community, the local residents shall be informed about the project and how their businesses can benefit from the project.	▪ Site Inspections ▪ Community Engagements	▪ Minutes of progress review meetings ▪ Project ESHS inspection report	▪ Monthly by contractor and FTF ▪ Quarterly by SE, KDMISTSC & MWE	▪ Construction & Operational phase	▪ Monthly	▪ Imbedded in cost of Monthly review meeting cost	▪ N/A
		Sensitization of the construction contractor and his staff about public health aspects mainly based on consumption of such food stuffs bought at the construction site from the locals.					▪ Quarterly	▪ Imbedded in cost of quarterly review meeting cost	▪ N/A
		Use of quality products with standards meeting Uganda national bureau of standards	▪ Review of purchase notes ▪ Farm	▪ Material report ▪ District planning		▪ Construction and Planting season	▪ Monthly	▪ Imbedded in cost of Monthly review meeting	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
			Inspection ▪ Review of FTF reports	meetings				cost	
4.	Infrastructure Improvement	The extent to which development becomes a positive or negative impact will be determined by the effectiveness of the town planning framework. Such induced developments shall be of a type that is desirable and sustainable and for this to happen, all future developments must be undertaken within the framework of proactive government policy and strict planning and environmental enforcement by the responsible Local Government.	▪ Review of scheme reports ▪ Stakeholder consultation ▪ Inspection of site	▪ Minutes of progress review meetings ▪ Scheme reports	▪ Thought scheme planning, implementation to decommission stage by; World Bank, Contractor, FTF, SE, KDMISTSC & MWE		▪ Quarterly	▪ District budget	▪ N/A
		Integration of sustainable development programs, such as youth empowerment, local road infrastructure linkage, but a few alongside the agricultural command area					▪ Quarterly	▪ District budget	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
5.	Increased Agricultural Activities	The farmers in the command area shallshall be sensitized about the advantages and adverse effects of chemical fertilizer through exhibitions and these inputs shall be made easily available through co-operative societies/ farmers associations. Liberal supplies of insecticides and pesticides shall be distributed at the cheap rates all over the Kanungu District following the Integrated Pest Management Plan.	▪ Farm Inspection ▪ Review of FTF reports	▪ District planning meetings	▪ Monthly by KDMISTSC, MAAIF	▪ Post Construction	▪ Planting season	▪ MAAIF & District budget	▪ N/A
		To save the farmers from the clutches of moneylenders, adequate credit facilities shall be made available at reasonable cheap rates in the project area. Credit societies and farmers associations shall be strengthened to provide loans to the cultivators. Moreover, integrated scheme of rural credit shall be implemented.	▪ Consultation of farmers associations and credit facilities ▪ Scheme Inspection	▪ District planning meetings ▪ Minutes of progress review meetings ▪ Scheme reports		▪ Post Construction	▪ Annually	▪ MAAIF & District budget	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		Deployment of Intergrated Integrated Pest Management Plan	▪ Crop pests and diseases control	▪ No of Capacity Building/ Training events ▪ Pest and Disease Surveillance ▪ Advisory support logs the holder who will maintain them. E.g, "Advisory support logs maintained by the District Agriculture Officer (DAO)	▪ FTF, KDMISTSC & MWE	▪ Post Construction	▪ Annually	▪ MAAIF & District budget	▪ 121,000,000
		Adoption of farm management software, this will help farmers in the command area to take complete control over farming activities and analyze usage of all inputs and expenses, so as to identify weak points and make proper improvements.	▪ Farmers consultation ▪ Farmer grievances logs	▪ Minutes of progress review meetings ▪ District planning meetings ▪ Adopted farm management software	▪ Quarterly by KDMISTSC, MAAIF & MWE	▪ Post Construction (Scheme operation)	▪ Monthly	▪ MAAIF & District budget	▪ N/A
		Increased coordination and planning by Kanungu District agricultural officers and Engineers, MAAIF,	▪ Stakeholder meetings ▪ Progress review meetings	▪ No of stakeholder grievances ▪ Minutes of progress	▪ Quarterly by World Bank, FTF, KDMISTSC, MAAIF & MWE	▪ Scheme operation	▪ Quarterly	▪ District budget	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		MWE, but a few concerning agricultural activities in the scheme		review meetings					
6.	Crop diversification	Sensitization of farmers regarding the adoption of pest resilient crops and technology arrangements shall be made for agricultural education and extension services. It would assist the farmers to take proper crop-care leading to increase in crop productivity.	▪ Scheme Inspections ▪ Community/ farmers Engagements		▪ Quarterly or planting season by FTF, KDMISTSC, MAAIF & MWE	▪ Scheme operation	▪ Quarterly	▪ MAAIF & District budget	▪ N/A
		Practice of seasonal soil rotation; it is important to understand how planting recurring crops can affect overall yield. Planting an alternating crop helps to diversify the demands on the soil. This results in crops that not only yield more, but continually produce year in and year out.		▪ Minutes of farmers engement meetings ▪ Minutes of planning meetings		▪ Post Construction (Scheme operation)	▪ Planting season	▪ N/A	N/A ▪
		Use of high quality and low-cost seed could be the basis for increasing crop yields. Using hybrid seeds that are					▪ Planting season	▪ N/A	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		naturally inclined to grow faster, stronger, and with greater efficiency is pivotal to the success of scheme.							
		By carrying out sound research and development initiatives on resilient crop types.					▪ Planting season	▪ MAAIF budget	▪ N/A
		Cropping technical assistance, through training on 'non-conventional' farming methods and on innovative ways to share farming knowledge to the command area cultivators.					▪ Planting season	▪ MWE budget	▪ N/A
		The selection of a low volatile or high productive cropping system.					▪ Planting season	▪ N/A	▪ N/A
7.	Expansion of Land under Irrigated Agriculture	Support of land reform that clearly defines property rights, ensure the security of land tenure, and enable land to be used as collateral will be necessary to realize potential productivity gains.	▪ Review of land related legal framework ▪ Scheme command area inspections	▪ Reviewed policy	▪ When required by policy makers	▪ Post Construction (Scheme operation)	▪ N/A	▪ N/A	▪ N/A
		Ensuring proper water drainage; water management is essential to crop	▪ Scheme Inspections ▪ Community/	▪ Minutes of farmers engement	▪ Quarterly or planting season by FTF,		▪ Planting season	▪ N/A	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		survival and maximizing yield potential. It's important to ensure that the irrigated crops are getting enough water, but also that they aren't being over-watered.	farmers Engagements	meetings ▪ Minutes of planning meetings	KDMISTSC, MAAIF & MWE				
		Community sensitization in regards to irrigation technology utilization.	▪ Site Inspections ▪ Community Engagements	▪ Minutes of progress review meetings ▪ Scheme inspection report			▪ Quarterly	▪ MWE budget	▪ N/A
		Integration of other government programs related to irrigated agriculture to support the scheme.	▪ Planning of scheme supporting government programs	▪ Minutes of planning meetings			▪ Annually	▪ N/A	▪ N/A
8.	Improved Food Security and Nutritional Status	Provision of intermediate technological solutions such as light machinery and affordable tools will encourage farmers in the command area to test them. New tools and practices can be better tested to the local conditions through participatory research	▪ Scheme Inspections ▪ Community/ farmers Engagements	▪ Minutes of progress review meetings ▪ Scheme inspection report	▪ Quarterly or planting season by FTF, KDMISTSC, MAAIF & MWE		▪ N/A	▪ N/A	▪ N/A
		Adoption of policies supporting private	▪ Grievances	▪ Reviewed	▪ When required by policy	▪ Post Construction	▪ N/A	▪ N/A	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		and public agricultural input and output, market development, and inducing adoption of more diverse, resilient, and profitable cropping systems	follow up ▪ Community/ farmers Engagements	policy	makers	(Scheme operation)			
		Adoption of crop diversification as a strategy for addressing food and nutritional security.	▪ Scheme planting inspection	▪ Minutes of progress review meetings ▪ Scheme inspection report	▪ Quarterly or planting season by FTF, KDMISTSC, MAAIF & MWE		▪ Planting season	▪ MAAIF budget	▪ N/A
9.	Improved Land Conditions	Sustainable utilization of fertilizers; cultivating farm land soil with fertilizers is an important part of maintaining optimal soil conditions for crops. Fertilizing the crops at the time of seeding will help provide the seeds with essential nutrients like potassium, phosphorous, and calcium.	▪ Scheme Inspections ▪ Community/ farmers Engagements		▪ Quarterly or planting season by, KDMISTSC, MAAIF & MWE	▪ Post Construction (Scheme operation)	▪ Planting season	▪ MAAIF & District budget	▪ N/A
		Scouting the farm land; this will give the farmers in the command area a chance to assess soil conditions, notice any weeds cropping				▪ Post Construction (Scheme operation)	▪ N/A	▪ N/A	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		up, and check if crops are growing healthily.							
		Regular testing of farmland soil quality; examining the phosphorus, potassium, and fertilization levels will give farmers in the command area an insight into how to handle the crops. It will also alert them, when proper soil conditions are forming, such as the optimal density and right amount of nutrients.	▪ Soil tests	▪ Soil quality results ▪ Minutes of progress review meetings ▪ Scheme inspection report			▪ N/A	▪ N/A	▪ N/A
		Weeding early and often; weeds are invasive, and siphon nutrients away from the crops that need to be continuously removed to reduce nutrient competition.	▪ Scheme Inspections ▪ Community/ farmers Engagements	▪ Minutes of progress review meetings ▪ Scheme inspection report			▪ N/A	▪ N/A	▪ N/A
		Applying conservation tillage practices as to save time, fuel and machinery wear.					▪ N/A	▪ N/A	▪ N/A
		Sensitization of farmers in the command area about the right type of fertilizers available, prices and applications	▪ Farm Inspection ▪ Review of FTF reports	▪ District planning meetings	▪ Monthly by KDMISTSC	▪ Post Construction (Scheme operation)	▪ Planting season	▪ District budget	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
			▪						
10.	Market Infrastructure	Marketing infrastructure shall be widened and strengthened to help the farmers to sell their products at better prices. There shall be proper arrangements for unloading of the produce in the markets.	▪ Stakeholder consultation ▪ Planning ▪ Inspection	▪ Minutes of progress review meetings ▪ Scheme inspection report ▪ National planning meetings	▪ Quarterly by, KDMISTSC, MAAIF, UNRA & MWE		▪ Harvesting season	▪ MAAIF and District budget	▪ N/A
		Price support policy shall be adopted and minimum prices shall be guaranteed to the peasants in the command area.	▪ Review of land related legal framework ▪ Scheme command area inspections	▪ Reviewed policy	▪ When required by policy makers		▪ N/A	▪ N/A	▪ N/A
		The farmers in the command area shall be supplied with quality inputs at proper times and at controlled prices.	▪ Training ▪ Scheme Inspections ▪ Community/ farmers Engagements	▪ Minutes of progress review meetings ▪ Scheme inspection repo	▪ Quarterly by, KDMISTSC, MAAIF, & MWE		▪ Harvesting season	▪ MAAIF and District budget	▪ N/A
		Farmers in the command area shall be encouraged to know the yield potential of the farmland, especially understanding the; field's growth potential, kind of crops to plant, and					▪ Planting season	▪ MAAIF and District budget	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		kinds of seeds to use, when assessing yield potential.							
		Marketing training of farmers in the command area, with content including; new skills, new techniques and new ways of obtaining information in agriculture	▪ Training review ▪ Scheme Inspections ▪ Community/ farmers Engagements	▪ Minutes of progress review meetings ▪ Training reports ▪ Scheme inspection repot	▪ Quarterly by, KDMISTSC, MAAIF, & MWE	▪ Post Construction (Scheme operation)	▪ Quarterly	▪ MAAIF and District budget	▪ N/A
11.	Enhanced values of the agricultural produce	To check the sub-division and fragmentation of holding, the movement of co-operative farming shall be launched. Co-operative farming would result in the adoption of modern technology on so-called big farms. In this way, agriculture in the command area will become profitable occupation through economies of large-scale farming.	▪ Scheme Inspections ▪ Community/ farmers Engagements	▪ Minutes of progress review meetings ▪ Scheme inspection repot			▪ N/A	▪ N/A	▪ N/A
		Planting early and effectively through choosing the right time to plant will be the best strategy to use. Planting early will result in				▪ Post Construction (Scheme operation)	▪ N/A	▪ N/A	▪ N/A

No	E&S anticipated **Positive** Impact		Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	**Implementation time**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
		increased yields by taking advantage of unexpectedly early favorable soil conditions.							
		More emphasis shall be made to set up cottage and small scale agro-produce industries. This will raise the income of the peasants and keep them busy during the off season.	▪ Industrial inspections	▪ Minutes of progress review meetings ▪ Scheme inspection report ▪ National planning meetings	▪ Quarterly by, KDMISTSC, MAAIF, UIA & MWE		▪ N/A	▪ N/A	▪ N/A
Monitoring for Positive Impact enhancement TOTAL								**1,771,000,000**	

Table 9-5: Environmental and Social Monitoring Matrix for Negative Impact

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
X							X					Enforce restrictions on unnecessary entry into the construction working area. Managing site access by defining site boundaries clearly and physically to prevent the community from entering the site and prevent particular objects from escaping. In other words, hording/ fencing off the construction site	Site Inspection	Project ESHS inspection report	Operation of the camp site, equipment yard, Dam site by SE, KDMISTSC & MWE	Pre-construction, construction and operation	N/A	N/A	N/A
X	X	X	X	X	X	X	X	X	X	X	X	Conduct awareness campaigns/ sensitization in schools and project communities about the risks of students/ locals coming close to the construction site.	Site Inspections Community Engagements	Minutes of progress review meetings Project ESHS inspection report	Monthly by Resident Engineer (RE) Quarterly by SE, KDMISTSC & MWE	Construction & Operational phase	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X		X					X					Safe vehicle speed limits shall be instituted and enforced at site including vehicle	Site Inspection Community consultations		Daily by Resident Engineer (RE)	Pre-construction, construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
												maneuvers around the site	Traffic Police consultations		Monthly by SE & FTF Quarterly by KDMISTSC & MWE	and operation			
X		X					X					Deployment of a contractors Traffic Management Plan (TMP) to reduce project traffic related community accidents	Site Inspection Review of traffic management plan Inquires with the traffic police and the community	No of community grievances Minutes of progress review meetings Project ESHS inspection report No of road kills and incidents Workers' grievances on speeds	Daily by Resident Engineer (RE) Once at start of project by SE, KDMISTSC & MWE	Pre-construction & construction	Once	Lumpsum	3,000,000
X							X					Empowering of scheme beneficiaries (farmers in the command area) public safety safeguard for the installed canals'	Review of registered community grievances Review of FTF reports Site inspection	District planning meetings	KDMISTSC	Scheme operation	N/A	N/A	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
													Community consultations						
X							X					The contractor will bear the full accountability of creation of a safe environment for both the project workers and the community at large. The contractor's management shall give priority to Health, Security, Safety and Environment. The contractor's management shall ensure that all employees, including subcontractors are aware of their personal responsibilities in maintaining an accident free and healthy work environment.	Review of scheme construction contract Project progress review meetings	Minutes of progress review meetings Project ESHS inspection report	Daily by Resident Engineer (RE) Monthly by SE & FTF Quarterly by KDMISTSC & MWE Quarterly monitoring by contractor	Pre-construction and construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
	X		X	X						X		All construction equipment shall be kept in good operating condition to avoid oil or fuel leakages that might contaminate water	Site Inspection Pollution control monitoring/ measurements	Pollution control monitoring report		Pre-construction, construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
												resources. Poorly maintained machinery shall not be allowed to operate on site. All routine maintenance of construction machinery and vehicles shall be carried out in a designated workshop / maintenance area with concrete hard standing surface and drainage to an oil interceptor.		Project ESHS inspection report					
	X									X		Water quality of the source (at construction site) shall be monitored on a monthly basis, with samples taken and analysed for all forms of contaminants benchmark to baseline results in Table 5-10	Review of water monitoring records			Scheme operation	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
	X				X					X		Any hazardous wastes including material soiled with hazardous wastes and empty containers of hazardous materials shall be stored in a designated	Site Inspection Pollution control monitoring/ measurements	Pollution control monitoring report Evidence of NEMA approved	Daily by Resident Engineer (RE) Monthly by SE & FTF	Construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												area on site for regular removal and disposal by a registered contractor. All other wastes generated during site preparation and construction shall be transported by the contractor or a company that has been specifically contracted to an authorized disposal area.		waste handler contract Project ESHS inspection report	Quarterly by KDMISTSC & MWE				
	X									X		Fuel handling and oil spill measures shall be implemented to prevent, control and address spill or leaks. Fuel and oil handling shall be assigned to trained personnel and done at designated places at the contractor's camp in accordance to relevant standards set by the Energy Regulation Board and Uganda Bureau of Standards.				Pre-construction, construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
	X	X										Continuous monitoring of air quality against regulate emissions, such as draft NEMA's air quality standards in the construction phase. Benchmark on Table 5-3	Review of air quality monitoring records	Pollution control monitoring report Project ESHS inspection report		Pre-construction, construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
	X	X		X						X		Use of fertilizers and pesticides meeting required standards, such as International Code of Conduct on Pesticide Management in adherence to the national Control of Agricultural Chemicals Act, 2010.	Farm Inspection Review of FTF reports	District planning meetings	KDMISTSC	Planting season	N/A	N/A	N/A
	X			X						X		Deployment of a contractors Soil Erosion Control Management Plan (SECMP) and Spill Management Plan (SMP) to alleviate water pollution impacts	Site Inspection Review of SECMP and SMP Review of water quality monitoring records	Pollution control monitoring report Project ESHS inspection report	Daily by Resident Engineer (RE) Once at start of project by SE, KDMISTSC & MWE	Pre-construction, construction	Once	Lumpsum	3,000,000
	X									X		The designation of flood plains may also be a useful measure that allows groundwater	Review of feasibility and design report	Feasibility and design report	MWE/ World Bank	Pre-construction	N/A	N/A	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												recharge in the command area and reduces peak discharges downstream.							
	X									X		The project shall acquire water abstraction permits with conditions to guide the amount of water to be abstracted as stipulated in the Water Supply Regulations (1999). Water abstraction will comply with rates allowed by the DWRM permit that will be obtained.	Request for water abstraction permits	Minutes of progress review meetings Project ESHS inspection report	Resident Engineer (RE) before commencement	Pre-construction,	Annually	Imbedded in cost of quarterly review meeting cost	N/A
		X										Select low emission equipment and those with low fuel consumption as much as practicable	Project fleet inspection Review of fuel logs		SE monthly		N/A	N/A	N/A
X		X	X									Shut down equipment when not in use to minimize idle time;	Site inspection	Pollution control monitoring report Project ESHS inspection report	Daily by Resident Engineer (RE) Monthly by SE	Once the equipment is not in use	N/A	N/A	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
X		X	X									As far as possible, source material from locations close to the construction sites to reduce haulage distances;	Review of Material source ESIS Site inspection	NEMA approved Material source ESIS Material source report Minutes of progress review meetings	Daily by Resident Engineer (RE) Monthly by SE & FTF Quarterly by KDMISTSC & MWE	On acquisition of material source sites	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
		X				X						No open burning of waste practice shall be adopted.	Site Inspections Community Engagements	Minutes of progress review meetings Project ESHS inspection report	Monthly by Resident Engineer (RE) Quarterly by SE, KDMISTSC & MWE	Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
	X	X								X		Reduced or no use of pesticides/ fertilizers through manual weed removal, placing traps and lures, removing pest breeding sites, growing more resistant plants, cropping native species that are naturally more resistant to native pests and	Farm Inspection Review of FTF reports	District planning meetings	KDMISTSC	Planting season	Planting season	MAAIF & District budget	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
												supporting biocontrol agents such as birds and other pest predators. Use of sustainable fertilizers and pesticides Proper application of sustainable fertilizers and pesticides, through following labelled directions, monitoring the weather when applying pesticides (avoid very hot or windy days)							
X	X	X		X								Covering of trucks delivering materials with tarpaulin to reduce the risk of fugitive dust emissions, especially in busy trading centres; to minimize exposure to agents of erosion such as wind and running water.	Site Inspections Community Engagements	Minutes of progress review meetings Project ESHS inspection report	Monthly by Resident Engineer (RE) Quarterly by SE, KDMISTSC & MWE	Construction/ Daily	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
		X		X						X		Limited vegetation clearing to the minimum shall be required for safe construction to	Material data sheets Site Inspection	Ecological report Site inspection report	Daily by Resident Engineer (RE)	Construction phase	Monthly	Imbedded in cost of Monthly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												minimise exposed areas and vegetation removal;		Minutes of progress review meetings	Monthly by SE & FTF Quarterly by KDMISTSC & MWE				
X		X	X		X							Drivers shall be sensitized, emphasising the need to stick to designated routes and speed limits.	Site Inspection Community consultations Traffic Police consultations	Minutes of progress review meetings Project ESHS inspection report	Monthly by Resident Engineer (RE) Quarterly by KDMISTSC & MWE	Pre-construction, construction and operation	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X		X			X		X					Optimize the logistics to maximize use of available vehicles, and therefore reduce number of trips	Review of JMP Site inspection	Minutes of progress review meetings	Daily by Resident Engineer (RE) r Monthly by SE	Construction phase	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
		X										Local weather stations often shall post local air quality information and weather forecast for the sub-counties.	Weather talk shows Agricultural planning talk shows	District planning meetings	KDMISTSC	Operational	Weekly	MWE budget	N/A
X	X	X					X			X		Deployment of a contractors Dust Management Plan (DMP) and Spill Management Plan	Site Inspection Review of DMP Review of air quality	Pollution control monitoring report	Daily by Resident Engineer (RE)	Pre-construction, construction	Once	Lumpsum	6,000,000

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
												(SMP) to alleviate air pollution impacts	monitoring records	Project ESHS inspection report	Once at start of project by SE, KDMISTSC & MWE				
X		X	X		X		X	X				Construction activities shall be limited to daytime;	Review of work plans Site inspection	Minutes of progress review meetings Project ESHS inspection report	Monthly and Quarterly by SE & FTF Quarterly by KDMISTSC & MWE	Construction phase	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X			X				X					The contractors on site shall be made aware of, and adhere to, the regulatory noise limits for a construction site in a commercial area (75 dBA) and that in a residential area (60 dBA) as provided for by the National Environment (Noise Standards & Control) Regulations, 2003;	Community consultation Review of Noise monitoring records	Pollution control monitoring report Project ESHS inspection report Minutes of progress review meetings		Monthly	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X			X									Deployment of a contractors Noise Management Plan (NMP) to alleviate Noise pollution impacts,	Site Inspection Review of NMP Review of noise quality		Monthly by MWE Staff Once at start of project by SE,	Pre-construction, construction	Once	Lumpsum	3,000,000

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
													monitoring records		KDMISTSC & MWE				
				X		X				X		Topsoil and subsoil removed from the site during site preparation shall be stored properly (away from runoff and possible contaminants) for reuse elsewhere or for backfilling and reinstatement	Site Inspection Review of excavation methodology		Daily by Resident Engineer (RE) Monthly by SE & FTF Quarterly by KDMISTSC & MWE	Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X				X					X			During reinstatement, the trench back-fill material shall be compacted to a level similar to the original surrounding soils to avoid subsidence as a consequence of rain water channelling.	Site Inspection Review of Restoration plan				Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X				X		X						All waste generated during site preparation and construction shall be transported to an authorized disposal area. The contractor will seek guidance from the Kanungu District Local	Site Inspection	Evidence of NEMA approved waste handler contract		Pre-construction, construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												Government of the respective project areas on the final disposal point.		Project ESHS inspection report					
	X	X		X		X	X					A Spill kit shall be maintained onsite to clean-up any accidental spills.	Site Inspections Community Engagements	Minutes of progress review meetings Project ESHS inspection report Pollution control monitoring report	Monthly by Resident Engineer (RE) Quarterly by SE, KDMISTSC & MWE	Construction/ whenever there is a spill	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
	X			X						X		Retention ditch shall be provided such that runoff from the project site does not go directly into neighbouring gardens or drain into the underground source.	Site Inspection Review of Restoration plan			Construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
	X			X		X				X		A Waste Management Plan (WMP) will be developed prior to start of construction activities.	Site Inspection Review of WMP Review of waste disposal methods	Pollution control monitoring report Project ESHS inspection report Minutes of progress review meetings	Daily by Resident Engineer (RE) Once at start of project by SE, KDMISTSC & MWE	Pre-construction	Once	Lumpsum	3,000,000
	X			X						X		Continuous monitoring of soil quality against regulate emissions (see appendix I)	Site Inspection Review of soil quality test records		Monthly by L& T, SE	Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
													Review of spill incident reports		Quarterly by KDMISTSC & MWE				
					X		X	X				All construction workers will be sensitized about responsible sexual behaviour with the communities.	Review of sensitization records Stakeholder engement consultations	Minutes of progress review meetings Grievances records		Construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
X					X			X				Workers prohibited from interaction with the school students.	Review of sensitization records Stakeholder engement consultations	Minutes of progress review meetings Grievances records		Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X					X		X	X				The contractor shall follow up any grievances from the community and the schools (Table 5-26.	Review of sensitization records Stakeholder engement consultations			Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
					X		X	X				Conduct background checks on all people before employment;	Validation of Contractors workers appointment letters and contracts	Contractors workers appointment letters and contracts	Quarterly by SE, KDMISTSC & MWE	Construction and operation	Annually		N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
													Community Engagements	Minutes of progress review meetings					
X					X		X					Hire security guards from a registered company that have records of each guard, to protect both the contractor and the project site;	Site inspection Review of security contracts	Minutes of progress review meetings Site Inspection reports	Daily by Resident Engineer (RE) Quarterly by SE, KDMISTSC & MWE	Pre-construction, construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
X					X		X	X				Collaborate with the local administration including; LC1s, police post and Kanungu District police station.	Site inspection Review of security MOU			Pre-construction, construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
X					X		X					"No Trespassing" signs will be prominently displayed on fencing or the perimeter of the job site. Such signs will discourage unauthorized intrusion onto the job site and if correctly worded aids in the prosecution of apprehended trespassers. "	Site Inspections	Minutes of progress review meetings Project ESHS inspection report Warring signs procurement records	Monthly by Resident Engineer (RE) Quarterly by SE, KDMISTSC & MWE	Construction phase	After fence construction	Imbedded in cost of quarterly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
X					X		X	X				Deployment of contractor's code of conduct	Review of Contractors ethical code of conduct	Minutes of progress review meetings	Weekly by Resident Engineer (RE) Quarterly by SE Pre-construction by MWE (Once)	Pre-construction, construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X					X	X	X	X				The contractors on site shall be made aware of, and adhere to community and Kanungu District bylaws, national legal frame work on social and health conduct.	Stakeholder engement consultations	Minutes of progress review meetings Community and workers grievances records	Weekly by Resident Engineer (RE) , SE Quarterly by KDMISTSC & MWE	Construction phase	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X					X		X	X				Deployment of a contractors Labour Management Plan (RLP), Cultural Plan, and Gender Mainstreaming Plan, HIV/AIDS Plan, Community Liaison / Engagement Plan, and Grievance Management Plan to alleviate impact of social misdemeanour.	Review of RLP	Minutes of progress review meetings	Monthly by Resident Engineer (RE) Once at start of project by SE, KDMISTSC & MWE	Pre-construction, construction and operation	Once	Lumpsum	12,000,000

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
X	X	X	X	X	X	X	X	X				Construction workers shall be provided with appropriate protective gear. The project contractors and sub-contractors shall be required to provide appropriate PPE for their workers to ensure that any risks are minimized to a level that is as low as reasonably practicable. Appropriate PPE shall be used by the construction workers to minimize the severity of accidents on site, if they occurred	Site inspection Review of PPE induction meeting minutes Validation of PPE procurement records Inquiry with workers on acquisition of PPE	Site inspection report Minutes of progress review meetings Project ESHS inspection report	Monthly by Resident Engineer (RE) Quarterly by SE and REA	Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
						X	X					Provide an area within the construction site to allow for sorting and segregation of materials	Site Inspection	Pollution control monitoring report Project ESHS inspection report Minutes of progress	Daily by Resident Engineer (RE) Monthly by SE & FTF Quarterly by KDMISTSC & MWE	Construction	Once		

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
														review meetings					
		X				X	X					Using dust suppression techniques (such as dampening with fine water spray and covering with tarpaulin);	Review of abstracted water Site inspection	Minutes of progress review meetings Community grievances		Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
						X						Continuous monitoring and annual Environmental and Social Audits of contractor's waste management practises against National Environment (Waste Management) Regulations, 1999 in the construction phase.	Review of Environmental and Social Audit ToRs and Report Site inspection		Annually by SE, KDMISTSC & MWE	Construction	Annually	Lumpsum	75,000,000
X					X		X					All project workers shall have to bear a project identification;	Site inspection		Daily by contractor Monthly by SE & FTF Quarterly by KDMISTSC & MWE	Pre-construction & construction	At recruitment		
X					X		X					All workers shall undergo an induction before commencement. It will also be through inductions that the contractor will ensure that all workers are	Review of induction material and records of attendance	Minutes of progress review meetings Project ESHS monthly report			Before mobilization		

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												conversant with resource conservation practices in all project activities.	Workers' safety practice inspection Community grievances						
							X					Tool box meetings at construction site sections on safe work practices shall be conducted daily;	Review of daily tool box meeting records and ESHS monthly report Workers' safety practice inspection			Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
							X					Safety training shall be conducted routinely on how to prevent and manage incidences on site;	Review of training material and records of attendance Workers' safety practice inspection Community grievances			Construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
							X					Providing of first Aid units fully equipped with the necessary materials; and train first aiders to administer it.	Site Inspection	No of workers grievances Minutes of progress	Daily by Resident Engineer (RE)	Pre-construction, construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	Monitoring Frequency/ Responsibility	Timing	Duration	Cost Description (all costs in UGX)	Impact Monitoring cost
														review meetings Project ESHS inspection report	Monthly by SE & FTF Quarterly by KDMISTSC & MWE				
							X					Personnel shall only undertake tasks for which they are trained/ qualified. A formal 'permit to work' system shall be in place and strict instructions shall be given for operators of equipment.	Review of training material and records of attendance Workers' safety practice inspection	Minutes of progress review meetings Project ESHS inspection report	Daily by contractor Monthly by SE Quarterly by KDMISTSC & MWE	Construction			
							X					Supervision of works shall be done regularly to ensure that safety conditions are met while any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work.	Site Inspection	No of workers grievances Minutes of progress review meetings Project ESHS inspection report	Daily by Resident Engineer (RE) Monthly by SE & FTF Quarterly by KDMISTSC & MWE	Daily during construction and weekly during operation	Daily	Imbedded in cost of Supervisory cost	N/A
X							X					Clear communication line shall be ensured between workers and operators/ drivers of heavy equipment.	Review of CMP and communication strategy	Minutes of progress review meetings	Daily by Resident Engineer (RE)	Construction			

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
															Monthly by SE & FTF Quarterly by KDMISTSC & MWE				
X							X					A qualified Health and Safety Officer shall be recruited by the contractor to oversee OHS matters on a daily basis and project safety committees shall be constituted	Interview of EHSO Review of EHSO contract	Interview report Minutes of progress review meetings	Monthly by Resident Engineer (RE) Quarterly by SE Pre-construction by MWE (Once)	Pre-construction & construction	Before mobilization		
X							X					A workplace registration license shall be obtained from Ministry of Gender Labour and Social Development (Department of OHS);	Review of issued workplace registration license conditions.	Minutes of progress review meetings Site Inspection reports	Daily by Resident Engineer (RE) At issue of license by SE, KDMISTSC & MWE	Construction	Annually	Imbedded in cost of quarterly review meeting cost	N/A
							X					The contractor shall bear and implement a Health and Safety Policy and Standard Operating Procedures that will be explained during induction; Continuous	Review of Contractors Health and Safety Policy and Action Plan	Comments from the review Minutes of progress review meetings	Monthly by Resident Engineer (RE) Quarterly by SE	Pre-construction	Before mobilization		

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												monitoring, Job hazard Analysis, regular OHS Audits against OHS legal frame work, such as; Occupational Health and Safety Act 2006, Employment Act 2006, Public Health Act Cap 281, Workers Compensation Act 2006, National Environment (Control of Smoking in Public Places) Regulations 2004, Traffic and road safety act, 1998, but a few in the construction phase.			Pre-construction by MWE (Once)				
							X					The contractor's management shall ensure that safe working methods are adopted for hazardous operations;	Review of safe guards in submitted work plans Review of deployed safe guards in daily reports Observation of deployment of safeguards	Comments from the review Minutes of progress review meetings	Monthly by Resident Engineer (RE) Quarterly by SE Pre-construction by MWE (Once)	Pre-construction & construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
X							X					Deployment of a contractors Environment Social, Health and Safety Plan (ESHSP) and Emergency Response and Incident Management Plan (ERIMP) to alleviate safety risks	Review of Contractors ESHSP and ERIMP	Comments from the review Minutes of progress review meetings	Daily by Resident Engineer (RE) Once at start of project by SE, KDMISTSC & MWE	Pre-construction	Once	Lumpsum	6,000,000
X					X		X					Deployment of project Grievance Management Plan (GMP) as to capture and handle worker safety reported risks and public safety related risks	Review of Contractors GMP Stakeholder engagement consultations Labour conditions auditing	Minutes of progress review meetings Workers' grievances records		Pre-construction & construction	Once	Lumpsum	3,000,000
X							X	X				The contractor shall use gender-sensitive language such as: "Go Slow, Work in Progress" instead of "Go Slow, Men at Work". This, coupled with women's visibility in construction works would, contribute to women's empowerment as well	Site signage inspection	No of grievances from Women Gender inclusiveness plan	Quarterly by SE, KDMISTSC & MWE	Construction	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												as breaking the stereotype that construction is a preserve of men.							
								X				The contractor shall sensitise project workers about gender discrimination and sexual harassment.	Consultation of women Review of gender related recorded or handled grievances	No of grievances from Women Gender inclusiveness plan		Construction and operation	Quarterly	Imbedded in cost of quarterly review meeting cost	N/A
								X				Contractor shall be encouraged to pay an equal 'living wage' to all workers involved in project implementation including women on the same job posts.	Validation of Contractors workers appointment letters and contracts Consultation of workers	Minutes of progress review meetings	Daily by Resident Engineer (RE) Quarterly by SE Pre-construction by MWE (Once)	Pre-construction, construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
X							X	X				The contractors on site shall be made aware of, and adhere to community and Kanungu District bylaws, national legal frame work guiding women inclusion and their rights protection, such as; Occupational	Review of Contractors GMP	Comments from the review Minutes of progress review meetings	Monthly by Resident Engineer (RE) Quarterly by SE Pre-construction by MWE (Once)	Pre-construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												Health and Safety Act 2006, Employment Act 2006, Public Health Act Cap 281, Workers Compensation Act 2006, but a few in the construction phase;							
X							X					Implementation of a Contractors Violence Against Children prevention and response plan.	Review of Contractors Violence Against Children prevention and response plan	Minutes of progress review meetings	Daily by Resident Engineer (RE) Once at start of project by SE, KDMISTSC & MWE	Construction	Once	Lumpsum	3,000,000
X							X					Continuous engagement with the stakeholders, including sensitization of the community about Violence Against Children (VAC)	Stakeholder engagement consultations	Minutes of progress review meetings Community grievances records	Monthly by L& T, SE Quarterly by KDMISTSC & MWE	Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A
									X			Sensitization of community members whose property shall be affected.	Review of community sensitization records	Minutes of progress review meetings	Weekly by Resident Engineer (RE) Monthly by SE & FTF	Pre-Construction	Monthly	Imbedded in cost of Monthly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
													Review of valuation methodology	Community engagement report	Quarterly by KDMISTSC & MWE				
									X			Completion of a full inventory of privately registered and/cultivated, grazed or other uses of the property that will be taken for the project as well as structures and graves within the scheme.	Review of RAP report Review of community grievance logs Engagement with the community		On completion of RAP by MWE and KDMISTSC				
									X			Compensation to be paid in line with mandated rates agreed in consultation with the respective Project District Officials before commencement of construction activities.			During RAP Implementation framework by MWE and KDMISTSC	Pre-Construction	Once	Cost included RAP implementation Report	N/A
									X			Ensuring that the Chief Government valuer approves the valuation rates			After review by CGV		Once		N/A
									X			Adhering to both National legal frame work, such as; Constitution of the			At both RAP development and Implementation				

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												Republic of Uganda, 1995; National Land Policy, 2013; National Irrigation Policy, 2017; National Agricultural Policy, 2013; Land Act, Cap 227, 1998; Local Governments Act Cap 243, 1997 and World Bank operational Safeguard requirements specifically OP 4.12 Involuntary Resettlement.			phases by MWE, KDMISTSC & CGV				
X					X				X			Continuous engagement with all project stakeholders, especially the local administration l leaders (Table 5-22) and the community foe project ownership. This shall include continuous project progress feedback/ reporting.			At both RAP development and Implementation phases by MWE, KDMISTS		Monthly	Imbedded in cost of Monthly review meeting cost	N/A
									X			Deployment of project Grievance Management Plan (GMP) as to capture and handle any			Daily by Resident Engineer (RE)		Once	Lumpsum	3,000,000

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
												land related grievances in relation to the project.			Once at start of project by SE, KDMISTSC & MWE				
	X									X		Adoption of environmental flow of 0.64 m3/s for low flow regimes and a one in two-year flood of 13m3/s of R. Kirurum	Review of Environmental Flow report Review of Ecological monitoring Site Inspection	Ecological report Site inspection report Minutes of progress review meetings	At feasibility study by MWE	Pre-Construction & Construction phase			
										X		An eco-friendly design shall be used to promote a green environment around the facility							
										X		Restriction of equipment to the project footprint and designated areas; Movement of crews and equipment within the right of way and through routes provided for access to the work site, shall be performed in a manner to prevent damage to crops or property			Daily by contractor Monthly by SE & FTF Quarterly by KDMISTSC & MWE		Monthly	Imbedded in cost of Monthly review meeting cost	N/A

Impact on public safety	Impact on local area water hydrology	Air Pollution	Noise Pollution	Degradation of soils and Soil erosion	Social Misdemeanour by Workers	Management of generated waste	Occupational Health and Safety	Impact on Gender	Land Take	Impact on project area ecology	Unsustainable Use of Resources	Proposed Mitigation Measures	Monitoring method	Performance Indicators (Means of verification)	**Monitoring Frequency/ Responsibility**	**Timing**	**Duration**	**Cost Description (all costs in UGX)**	**Impact Monitoring cost**
				X						X		A restoration plan for the opened-up areas shall be drawn and followed to ensure re-establishment of the original vegetation. Deployment of decommissioning plan and Restoration plans for all sites to alleviate biodiversity loss.					At decommissioning	Lumpsum	50,000,000
Monitoring for Negative Impact TOTAL																		170,000,000	
TOTAL MONITORING COST IS 1,941,000,000																			

9.5.3 Capacity Development and Training Requirements

Training	Phase	Budget line	Frequency	Responsible agency
HSE Training	Construction	Contractors	Quarterly	Contractor/Environmental and Social Safeguards Supervision and Monitoring Consultant
Crop pests and diseases control	Operation	District	Quarterly	Kanungu District Production Department
Produce Marketing	Operation	District	Quarterly	Value Addition Consultant

9.6 Scope of the Project Decommisioning Plan

The implementing agency shall prepare a project decommissioning plan which shall be reviewed and approved by the regulating agency. The scope of the decommissioning plan shall comprise the following:

- Brief overview of the irrigation project.
- Rationale for decommissioning (e.g., economic factors, environmental concerns, new technologies).
- Key objectives of the decommissioning plan.
- Permitting Requirements: Identify the necessary permits from local, state, or national authorities.
- Compliance: Ensure compliance with environmental laws, water rights, and safety regulations.
- Stakeholder Engagement: Identify and engage with stakeholders (farmers, communities, environmental groups) to manage concerns.
- Site Analysis: Evaluate the current environmental conditions at the site.
- Potential Impacts: Assess the potential environmental impacts of decommissioning, including effects on soil, water quality, and local ecosystems.]
- Mitigation Strategies: Develop strategies to mitigate any negative environmental impacts.
- Asset Inventory: List all equipment, structures, and materials that will be removed, reused, or recycled.
- Irrigation Infrastructure: Determine the steps for dismantling the irrigation infrastructure (e.g., canals, pipes, pumps).
- Soil and Water Management: Plan for managing soil and water during and after decommissioning, including erosion control and water redirection.
- Waste Disposal: Develop a waste management plan for the disposal of debris, hazardous materials, and non-recyclable items.
- Risk Assessment: Identify risks associated with decommissioning activities (e.g., heavy machinery use, hazardous material handling).
- Safety Measures: Implement safety measures to protect workers, the public, and the environment.
- Training: Provide training for workers involved in the decommissioning process.
- Economic Effects: Assess the economic impact on the local community, including job losses and changes in land use.
- Compensation: Determine compensation strategies for affected parties, such as landowners and water users.

- Alternative Solutions: Explore and propose alternative irrigation or water management solutions for the community.
- Project Phases: Outline the phases of the decommissioning project with estimated timelines for each phase.
- Cost Estimates: Provide a detailed budget, including costs for labor, equipment, environmental restoration, and unforeseen expenses.
- Contingency Planning: Include contingency funds and plans for dealing with unexpected challenges or delays.
- Site Rehabilitation: Outline plans for restoring the land to its natural state or repurposing it for new uses (e.g., agriculture, recreation).
- Monitoring and Maintenance: Develop a plan for ongoing monitoring of the site to ensure that restoration efforts are successful.
- Reporting: Establish a system for reporting the outcomes of the decommissioning project to regulatory bodies and stakeholders.
- Public Engagement: Develop a communication plan for informing the public about the decommissioning process, timelines, and impacts.
- Stakeholder Updates: Regular updates to stakeholders and partners throughout the project.
- Final Report: Create a final report summarizing the decommissioning process and its outcomes.

10 CONCLUSION

Construction of Matanda irrigation scheme will provide farmers in the 9000 Ha with access to irrigation and other agricultural services, and contribute to improvement of farm incomes, rural livelihoods, food security, climate resilience, and sustainable natural resources management. This Environmental and Social Impact Assessment (ESIA) was undertaken with the aim of assessing potential impacts that the proposed project will have on both the bio–physical and social environments, with an output of an ESMMP.

The key safeguard policies and legal framework triggered by the proposed project include; National Water Policy, 1997; National Irrigation Policy, 2018; National Agricultural Policy, 2013; National Environment Act, 2019; Water Act, Cap 152, 1997; Seeds and Plant Act, 2006; Agricultural Chemicals (Control Act), 2006; and the World Bank Operational Policies (OP) on environmental and social safeguards: OP 4.01, Environmental Assessment; OP 4.04, Natural Habitats; OP 4.09, Pest Management; OP 4.10, Indigenous Peoples; OP 4.11, Physical Cultural Resources; OP 4.12 Involuntary Resettlement; OP 4.37 Safety of Dams; and OP 7.50 Projects on International Waters.

The major concerns and suggestions from stakeholder engagement under this study covered land acquisition and compensation for affected property, employment expectations and local content, proper waste management, prevention of spread of HIV/AIDS, prevention of negative impact on physical cultural resources, water sources, and cultural sites, as well as prevention of social ills such as family breakage, defilement, rape, and theft, among others.

Biodiversity assessments revealed that there were no sensitive ecological receptors in the command area, and most of the species identified were largely of Least Concern (LC) according to IUCN. However;

- Spotted necked otter, threatened as listed by both IUCN (global) and the National Lists (WCS 2016),
- Grey Crowned Crane, Endangered Species (EN) at both global and national categorisation but Regionally Near Threatened, was recorded in the command area, and
- *Labeobarbus* sp. (formerly genus *Varicorhinus*) within the Mount Rwenzori foothills, ranked as Vulnerable (VU) due to its restricted habitat range according to the IUCN Red Data Lists was recovered in River Kiruruma.

The pipeline network was re-aligned over 150 meters away from the boundary of Queen Elizabeth National Park to minimize the risks Human Wildlife Conflics (HWC). In addition, UWA has advanced the construction of an electric fence along the entire boundary of the QENP and the command area at Ishaha Sector to prevent HWC. The electric fence is currently over 80% complete and commissioning is expected by March 2025.

A number of benefits will ensue from construction of the proposed irrigation scheme, including; Transformation of agriculture practice in the areas, Sustainable and optimal use of irrigation water resources, Benefit to local retail businesses, employment opportunities, Improved Land Conditions and household acreages, Crop diversification and intensification, Expansion of Land under Irrigated Agriculture, Improved Food Security and Nutritional Status, Enhanced values of the agricultural produce, and Tourism Potential. However, as with infrastructure and development projects of this scale, the scheme will inexorably result in a number of risks and both direct and indirect negative impacts on the physical, biological and socio-economic environment in the project area. As identified during the study, these risks and impacts relate to public safety, local area water hydrology, air and noise pollution, degradation of soils and soil erosion, social misdemeanor by workers, waste generation, occupational health and safety, impact on gender, land take and impact on project area ecology.

Most of these impacts are limited to only the duration of the Pre and Construction Phase (5 years) and can be mitigated through the comprehensive measures that have been outlined in this report, which if implemented will significantly reduce the risks and negative impacts or even eliminate some of the impacts.

With respect to alleviation of anticipated negative impacts and enhancement of positive benefits for this project, a cost of 1,771,000,000 Ugx and 170,000,000 Ugx has been estimated for Environmental and Social Management and Environment and Social Compliance Monitoring, respectively.

During Project implementation, the following measures shall be taken to ensure compliance with environmental and social safeguards;

a. The Contractor, Supervising Consultant and MWE shall have a team of Environmental and Social Development Specialists to oversee implementation of the ESMMP. Lead / Regulatory Agencies shall regularly visit the project as a team to ensure compliance with approval conditions in the certificates of environmental and social impacts assessment, conditions in the permits and licenses and mitigation measures contained in the ESMMP, method statements of Contractors and World Bank's safeguards.
b. Mitigation measures identified within this report shall be incorporated, as far as is practically possible, within the design details, specification, and contract documents to be drawn up for the project with sound environmental practices. The ESMMP shall be incorporated in the project Bills of Quantities such that all costs relating to environmental and social management and monitoring are included in the project overall investment cost.
c. The Contractor, and Supervising Consult shall have teams of competent Environment, Health and Safety Officers (NEMA certified with certificate/diploma in OHS) and a Community Liaison Officer, among other staff, who will monitor the implementation of the ESMMP.
d. Contractor shall be required, in the tender documents, to prepare standalone Environmental and Social Management and Monitoring Plans (ESMMP). These shall be reviewed and approved by MWE to guide implementation of environmental and social mitigation measures during the project implementation phase. This shall be done before commencement of construction activities.
e. The contractor shall obtain necessary permits and agreements as detailed in this report.
f. MWE and Kanungu District Local Government shall undertake continuous sensitization of stakeholders and collaboration with the established Farmer's Task Force through the local authorities.
g. On completion of project works, all sites disturbed by the project works shall be restored to as near as possible their original state as it was prior to commencement of the project works.
h. Individual Environmental Assessments shall be carried out for the Construction camp and material borrow and quarry areas by the Contractor, before commencement of works. The studies shall be spearheaded by qualified and registered EIA practitioners.
i. Monthly reports shall be prepared by the Contractor and submitted to MWE on operational compliance with the statements/measures in this ESIA report.
j. As required by the National Environment Audit Guidelines, MWE shall procure services of a NEMA registered auditor to undertake annual Environmental and Social Audits of the Project.

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APPENDICES in Volume II