

**ENVIRONMENTAL IMPACT ASSESSMENT PROJECT REPORT FOR THE
PROPOSED GEM RAE IRRIGATION SCHEME INFRASTRUCTURE
CONSTRUCTION, KISUMU COUNTY**

**Proponent CHIEF OFFIER OF AGRICULTURE LIVESTOCK AND FISHERIES
COUNTY GOVERNMENT OF KISUMU P.O BOX2738-40100 KISUMU, KENYA**

I Dr. Walter Alando a registered a registered expert (Expert Registration No--) on behalf of my team submit this Environmental Impact Assessment (EIA) Study Report for the proposed Gem Rae Irrigation Scheme Infrastructure Construction. The EIA has been carried out in accordance with the Environmental Management and Co-ordination Act, 1999 (EMCA) Part VI , Section 58 (1) and (2), Environmental (Impact Assessment and Audit) Regulations, 2003 and The physical planning Act (1996), Setion A6, 24 (2), 30(1) and Third Schedule PART (c).

Signed at KISUMU on this _____ day of _____ 2020

Signature: _____

Designation: EIA/AUDIT LEAD EXPERT REG No _____

I Paul Omanga on behalf of Kisumu County Government, submit this Environmental Impact Assessment (EIA) study Report, for the proposed Gem Rae Irrigation Scheme Infrastructure Construction.

Signed at KISUMU COUNTY on this _____ day of _____ 2020

Signature: _____

Designation: CHIEF OFFICER FOR AGRICULTURE, LIVESTOCK AND FISHERIES

The Environmental Impact Assessment was done in November, 2019

Solid (non-hazardous) wastes:	Generally include any garbage, refuse. Examples of such waste include domestic trash and garbage; inert construction / demolition materials; refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste).
Point sources:	These are discrete, stationary, identifiable sources of emissions that release pollutants to the atmosphere (e.g. incinerators).
Biodiversity loss :	The deminishing among living organisms from all sources including terrestrial ecosystems, aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, among species and of ecosystems.
Proponent:	A person who is proposing or executing a project, programme or an undertaking specified in the Second Schedule of the EMCA 1999.
Developer:	A person who is developing a project which is subject to an Environmental Impact Assessment under the EMCA 1999
Environment :	Physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odor, taste, the biological factors of animals and plants and social factor of aesthetics , culture and includes both the natural and the built environment.
Environmental Audit:	The Systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing in conservation or preservation of the environment.
Environment Impact Assessment	A systematic examination conducted to determine whether or not a programme, activity or project will have any adverse impacts on the environment
Project	Includes any project, programme or policy that may have an impact on the environment

LIST OF ACRONYMS AND ABBREVIATION

CPP - Community Participation in Procurement

CIDP - County Integrated Development Plan

DANIDA - Danish International Development Agency

DAO - District Agriculture Officer

DDO - District Development Officer

DIO - District Irrigation Officer

EIA - Environmental Impact Assessment

EIRR - Economic Internal Rate of Return

EMCA - Environmental Management and Coordination Act

ERSWEC - Economic Recovery Strategy for Wealth and Employment Creation

ESA - Environmental Sensitive Areas

ESAP - Environmental and Social Assessment Procedures

ESIA - Environmental and Social Impact Assessment

EIAA - Environmental Impact Assessment Audit

EA - Environmental Audit

EU - European Union

EURGAP - European Good Agricultural Practices

GOK - Government of Kenya

NEMA - National Environmental Management Authority

NEAP - National Environmental Action Plan

NPEP - National poverty Eradication Plan

NPNRMD - National Policy Water and Resources management and Development

OSHA - Occupational Safety and Health Act

NEC - National Environmental Council

SIDP -Small Holder Irrigation Development Project

PIU- Provincial Irrigation Unit

ICT- Information Communication Technology

ECD- Early Child hood Development

EMP- Environmental Management Plan

PCU- Project Coordination Unit

EXECUTIVE SUMMARY

The County Government of Kisumu through the Department of Agriculture, Livestock and Fisheries, intends to establish Gem Rae Irrigation Scheme Infrastructure Construction. The proposed project seeks to improve functionality of existing infrastructure of the Kisumu County.

The project is in line with the Kenya's Vision 2030 which aims 'To improve the overall livelihoods of Kenyans, the country aims to provide an efficient livelihood improvement systems with the best standards.

THE PROJECT: PROPOSED ACTIVITIES

The project which will cost *Ksh.30,909,370 (one hundred and eleven million, nine hundred and nine thousand, three hundred and seventy only)* will comprise work on **construction of irrigation scheme infrastructure facility in Gem Rae**

These facilities will include:

- ✚ Ground clearing
- ✚ Site construction
- ✚ Excavation of drainage channels
- ✚ Irrigation pipes
- ✚ Irrigation gate valves
- ✚ Feeder roads;
- ✚ Offices;
- ✚ Work stores;

INSTITUTIONAL FRAMEWORK

The ESIA was conducted under the following policy, legal and institutional framework Policy Framework:

- a) Sessional Paper No. 6 of 1999
- b) Sessional Paper Number 1 of 2002
- c) The National Poverty Eradication Plan (NPEP)
- d) The Poverty Reduction Strategy Paper (1999)

- e) Vision 2030
- f) Sessional Paper No. 3 of 2009 on National Land Policy

Legal Framework:

- a) The National Environmental Council (NEC)
- b) Environmental Management and Coordination Act (EMCA), 1999
- c) The Environmental (Impact Assessment and Audit) Regulations, 2003
- d) Waste Management Regulations, 2006
- e) Noise and Excessive Vibrations
- f) Water Quality Regulations, 2006
- g) Water Act, 2002
- h) The Occupational Safety and Health Act, 2007
- i) Building Operations and Works of Engineering Constructions
- j) Public Health Act (Cap. 242)
- k) Physical Planning Act, 1999

Institutional Framework:

- a) National Environmental Management Authority (NEMA)
- b) Ministry of Agriculture, Livestock and Fisheries
- c) Kisumu County Government
- d) Physical Planning

ANALYSIS OF ALTERNATIVES

“No- Action” Scenario

The “no-action” option would eliminate the opportunity to improve livelihood especially for the poor, potential jobs creation, and secondary socio-economic benefits, which the proposed development would have created. Simply because there is no capability for the area to handle community livelihood improvement, not mean there are no people in communities who require

such improvements. Similarly it is not true that a county without capability to provide modern farming technologies does not encounter this need.

“Action” Scenario

The major benefits of the proposed project lie in improving availability and access to livelihood sources not available due to dilapidated infrastructure or facilities at the Gem Rae Irrigation Scheme. Therefore this provide adequate justification for the proposed project to be implemented.

POTENTIAL SOCIO-ENVIRONMENTAL IMPACTS

The report analyses potential project impacts and proposes mitigation (or enhancement) measures and impact management recommendations. These are summarized below.

1. Construction-Phase Impacts

a) Positive impacts

Income to material/ equipment suppliers and contractors

Proposed extension, alteration and refurbishment will necessitate procurement of equipment, construction materials and service, providing income to suppliers and contractors. This is a positive but short-term and reversible impact.

Employment – socio – economic benefit

Several positive impacts are expected from the development of the projects. These include the generation of employment for skilled and unskilled labour in the short to medium term.

b) Negative impacts

i. Mud and particulate matters generation during construction

During the construction phase the earth work will generate mud during excavation. The mud can find its way to water course hence pollution. During dry season this might generate particulate matter and the situation may be reinforced by traffic movement

Impact mitigation measures

Since this area is a wetland there will be no much dust generate and this activity will be carried out during dry spell therefore mud will not be an issue.

ii. Noise levels

Construction hand tools and transport trucks will be a major source of noise to the surrounding areas. This will affect the workers and surrounding. It was noted that the immediate southern land has not been developed and hence effects of noise during construction will not have significant social implications.

Impact mitigation measures

- Initiate a noise mapping programme and keep monitoring,
- Undertake an annual hearing survey of all the workers,
- The contractor should ensure that noise levels emanating from machinery, vehicles and noisy construction activities are kept at a minimum for the safety, health and protection of people in buildings being renovated.
- Training, provision of ear muffs/corks and enforce application,

iii. Injury to workers by construction activities

The construction activities will be carried out during the installation of the irrigation infrastructures. This will involve the use of construction materials equipment and machineries. During this period things like accidents are likely to occur.

Impact mitigation measures

- Contractors should cordon off areas under construction.
- Ensure good housekeeping and clean operations always immediately removing rubble strewn outside construction areas.
- Construction workers should be aware of the sensitive nature of workplaces they are operating in and advised to limit verbal noise or other forms of noise. For example, metallic objects or tools can be passed on to a colleague below to be quietly laid down instead of dropping them on cement etc.
- Contractors should use screens or nets to avoid flying debris.
- Besides supervision by county engineers, contractors' contracts can have a clause authorizing a county works officer to advice contractors against careless handling of machineries.

iv. Solid waste

During the construction period there will be generation of different types of solid wastes within and around the site. The earth moving work daily operation activities will generate solid wastes.

Impact mitigation measures

- Disposal of waste would be done in accordance to waste regulations.
- Contractor to undertake safe waste disposal,
- Verify legality of waste disposal destination

v. Social impacts

There are no displacements or direct interference with any social groups within and around the site since no settlements were found at the time of this assessment. Anticipated social impacts would be related to gaseous emissions, generation of mud, dust and noise but there are no inhabitants in

the immediate neighborhood of the site. However for any eventuality the following mitigation will be adopted.

Impact mitigation measures

- Address concerns of neighbouring land users as per this report,
- Integrate public safety in the construction process,
- Utilize local labour for construction for enhancement of social harmony

vi. Biodiversity loss

There will be little disturbance to biodiversity at the site location being covered by mono plant grass and rice fields. Establishment of new vegetation will be done in the area after installing the facility.

Impact mitigation measures

- Introduction of vegetations (trees, shrubs and grass) on open spaces within and around the site.
- Indigenous species would be preferred.

vii. Water Quality

There is permanent source of surface water (River Awach) at the site vicinity. Therefore there are anticipated impacts on water quality. These include, oil spills from the machinery and depositions at the construction site camp has the potential for contamination of surface runoff (that may eventually end up into surface water streams) or infiltrate into the groundwater sources. The sediment from the excavation exercise can also pollute down stream water by increasing suspended solids.

Mitigation measures

- The contractor will ensure the standard regulations guidelines are followed and adhered to
- Oil spillage chances will be minimized since machineries will be serviced regularly

viii. Health and Safety

The main concern in this regard is the occupational welfare of the construction workers from the emissions from the machineries and the risk of accidents. Health and safety concerns will eventually be addresses during the operation states of the station. The concerns are projected to come from the excavation and generation of mud and handling process. Neighbouring residents are not likely to be affected since the construction site will be fenced off to keep off intruders.

There will be increased likelihood of increased incidences of diseases like bilhazias and malaria among workers. For bilhazia the worker will be provided with appropriate work gears and for malaria, use of treated mosquito nets will be promoted. There will be also likelihood of increased prevalence HIV/AIDS.

Mitigation measures

- The HIV/AIDS will be addressed through integrated approaches like awareness creation among the workers and communities and establishment HIV/AIDS management approaches.
- Malaria control campaign through use of treated mosquito net and prophylaxis
- Bilhazia problems will be addressed through awareness on use of protective gears and vaccination among workers.

ix. Traffic accidents

Construction activities may result in a significant increase in number of heavy vehicles during transport of construction materials and equipment, increasing community risk of traffic related accidents or injuries to workers. Traffic accidents would be a significant social impact and especially likely to involve children, women (who commonly cross roads slower than men), disabled and elderly people. Impact duration will be short-term occurring only during the construction phase. Extent of this impact will be on all roads plied by project vehicles. The likelihood of the impact occurring is high when control measures are not instituted. The social cost and significance of this impact is high especially if it involved loss of human life which is also irreversible.

Impact mitigation measures

1. Adopt best transport safety practices with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public, as follows:
 - Emphasizing safety aspects among project drivers. Specifically ensure drivers respect speed limits through built areas and urban centers.
 - Adopting limits for trip duration and arranging driver rosters to avoid overtiredness
 - Avoiding dangerous routes and times of day to reduce the risk of accidents Position traffic guides at children crossings to control diver speeds.
 - Employ safe traffic control measures, including road signs and flag persons to warn of dangerous conditions and children crossings.
 - Ensure contractors regularly maintain vehicles to minimize potentially serious accidents such as those caused by brake failure commonly associated with loaded construction trucks.

2. Operation Phase Impacts

a) Positive impacts

Improved food security services at healthcare facilities

The project will have a long-term positive impact on food security and livelihood in Kisumu County and Kenya as a whole. The construction of new irrigation infrastructure will enhance improved rice production.

Employment opportunities

The construction of the infrastructure process will result into expanded scheme that will provide employment opportunities' to the locals like professional laborers and security guards, etc.

Improved incomes

Farmers in the scheme will realize improved production of rice which they will sell to boost their households' incomes.

Improved aesthetics and life of irrigation facilities

Construction will improve aesthetics of the scheme which, in present state, look unplanned. Construction will also give the scheme extended life.

a) Negative impacts

i. Air Quality

Holding areas for the irrigation water is likely to produce methane and other greenhouse gases that will find their way into the atmosphere. This will result into global warming in the area, however this might not be significant since this is small scale irrigation system.

Impact mitigation measures

- Install gadgets to estimate the greenhouse gases emissions around the premise.
- This is a small scheme that cannot produce significant amount of greenhouse gases.

ii. Water Quality

There is permanent source of surface water (River Awach) at the site vicinity. Therefore, there are anticipated impacts on water surface water quality. The irrigation activities will result into water disturbance and enhance nutrients.

Impact mitigation measures

Continuous water quality parameters assessment through regular measurement of water quality indicators and analysis of nutrients.

iii. Environmental problem

The key environmental pollution anticipated from the site activities includes the following;

- Discharging irrigation wastewater into open river system around the construction site that would subsequently be carried into public water sources through surface runoff.

- Residuals suspended solids, oils and lubricant residuals as well a mixture of any contaminants brought along the materials. This has potential impacts on peoples health and the aquatic life,
- Discharge of oil residuals into open drains from point sources (moving machine parts, storage areas, delivery bays, etc) are potential sources of environmental contamination,
- Disposal of inert solid waste from the premises could become an extended environmental problem that would affect physical environmental quality, biodiversity and public health at points of disposal.
- Increased evaporation in irrigated areas can cause instability in the atmosphere, as well as increase levels of rainfall downwind of the irrigation. These changes to the climate are a direct result of changes to natural moisture levels in the surrounding atmosphere.
- Increased incidences of flooding in the area **Impact mitigation measures**
- Equipment specifications to conform with environmental standards,
- Integrate environmental components in the site design (waste management, emission controls, etc.),
- Apply to the extent possible provisions of the waste management regulations, County Government laws and by-laws, Public Health Standards, etc.,
- Enhance in-house awareness and sensitization on environmental protection initiatives,
- Flooding will be addressed by installing water control gate valves to monitor the amount of water permitted in and released.

iv. **Health and Safety**

There will be increased likelihood of increased incidences of diseases like bilhazias and malaria among workers. For bilhazia the worker will be provided with appropriate work gears and for malaria, use of treated mosquito nets will be promoted.

Mitigation measures

- Malaria control campaign through use of treated mosquito net and prophylaxis
- Bilhazia problems will be addressed through awareness on use of protective gears and vaccination among workers.

v. **Misuse or inability to use installed infrastructures**

This project would be in vain if farers and technical staff had no requisite training and skill to use constructed infrastructure for improved service delivery. This would be a significant, negative medium-term but reversible impact.

Impact mitigation measures

- Provide requisite training during infrastructure installations.

- There will be regular supervision, ensure only trained authorised personnel operate equipment.

vi. Not maintaining improved facilities

When improved facilities are not continually maintained, they would quickly degenerate to preproject condition. This would be a negative, significant medium-term impact of local spatial extent but reversible.

Impact mitigation measures

- The design will ensure frequent assessment and maintenance of the facility to safe guard the deteriorating condition.

Conclusion

The proposed project has potential to significantly improve food security and household income in Kisumu County with socio-environmental benefits such as employment, improved livelihood and increased productivity of labor hence higher household incomes. Besides, project development and operation will provide considerable economic opportunity for material/ equipment suppliers and construction contractors.

A key significant negative impact will arise from excavation of land, waste management, especially solid waste. There is also likelihood of increased incidences of malaria and bilhazia. This impact will be addressed through public awareness on use of treated mosquito net and use of protective gargets to evade bilhazia infections. Water quality deterioration is also an eminent impact on water in River Awach. This will be addressed by frequent water quality monitoring to a certain the quality parameters.

All potential adverse impacts are litigable when measures proposed (Chapter 7) are implemented, in which case benefits of this project to the nation would by far outweigh potential negative effects.

The proponent of the proposed project shall be committed to putting in place several measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project. It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the EMP as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects. It is expected that the positive impacts that emanate from such activities shall be maximized as much as possible as exhaustively outlined within the report. These measures will go a long way in ensuring the best possible environmental compliance and performance standards.

It is our recommendation that the project be allowed to go on provided the mitigation measures outlined in the report are adhered to, Environmental Management Plan (EMP) is implemented and the developer adhere to the conditions of approval of the project.

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CHAPTER ONE: INTRODUCTION

The following is a brief description of the project background (Gem Rae Irrigation Scheme, objectives and project identification/justification. The report has been prepared to include as much information as possible in order to make environmental self-audits easier.

Gem Rae Irrigation Scheme is a rice-growing smallholder irrigation scheme close to Lake Victoria, about 30 kilometres from Kisumu City, Kisumu County. Topography across the scheme is flat with an average gradient of about 0.5% and prior to irrigation the area was mainly swampland prone to flooding. The prevailing soils across the scheme are medium to heavy, dark grey or black clay soils suitable for rice cultivation. The scheme is in the lower midlands agroecological zone classified as humid/arid. Annual precipitation is 1250mm with peaks in April and November. The rainfall pattern is unpredictable, however, with monthly maximum typically two or three times the mean. Temperatures are fairly constant throughout the year with monthly maximum ranging from 25°C and 35°C. Most residents are food insecure despite their participation in smallholder irrigation.

The Scheme was developed in 1985 under the EEC-funded Smallholder Rice Project (SRP), Gem-Rae is one of the four cluster schemes in the Awach-Kano delta scheme designed to irrigate 350 hectares of rice. This scheme, like the other cluster schemes (i.e., Oyani-Nyachoda, Alara and Kopudo), shares the same source of water as from the Awach-Kano River.

The Awach-Kano River originates from within the Nyando basin and carries an appreciable amount of sediment, mainly sand and pebbles. The round-shaped pebbles indicate that the sediment has been transported as bed-load over a long distance. Due to this load, the intake (comprising a 6-m long concrete weir structure) started clogging up at the onset of the scheme. In the initial years, because of the frequency of sediment deposition, irrigation was undertaken only once every 2 years after removal of the sediment. However, after 4 years, sediment deposition at the intake as well as the main canal became so frequent that its removal had to be done at the start of every planting season (commencing July, every year). From 1992, the amount of sediment accumulation accelerated (suggesting that the erosive effect upstream of the river was also increasing) to the point that it had to be removed as often as three or four times during the entire 4-month growing season. From 1995, the removal of sediment was as frequent as twice a week.

The high rainfall patterns experienced in Kenya in 1997 due to the El Niño phenomenon sounded the death knell for the scheme. During this period, clogging of the intake became a weekly event and farmers were clearing sediment daily at the expense of farming. Maintenance records from the scheme indicate that as much as 200 m³ of sediment was being removed weekly during this period from the intake as well as a section of the main canal.

From its inception until 1995, the Ministry of Agriculture financed the farmers to undertake maintenance work (mainly removal of sediment). Though sedimentation was controlled after the withdrawal of the financial support and the El Niño rains, the farmers could no longer cope with the situation.

Since 1997, sediment clearing stopped and the intake and part of the main canal have been completely clogged up. No water is therefore received within the scheme and the canals, and other irrigation structures (division boxes, off take structures, etc.) have become nonoperational and are

either clogged up with earth or overgrown with vegetation. Formerly well-demarcated rice fields have been overgrown with reeds.

Driven by the hunger now prevalent in the area, several farmers are attempting to clear a part of the new swamp in a bid to produce some rice using residual water in the swamp. The yields are less than 0.5 t ha^{-1} , compared to 3.5 t ha^{-1} obtained previously. Less than 30 hectares are currently under this type of rice production and the Quelea birds that now inhabit the swamp consume most of the crop before it is harvested.

The Gem-Rae irrigation scheme has almost been virtually abandoned because of the high sedimentation problems experienced. Another reason is the weak management structure. However, the principal reason seems to be sedimentation originating from the uplands. Rice production is one of the few livelihood alternatives in the area and, thus, farmers remain interested in reviving the irrigation scheme although the cost of rehabilitation is beyond their resources.

The current irrigated area is approximately 90 ha with a total of 270 plots averaging 0.3 ha. There are 250 landowners. A further 28 ha is occupied by out growers on the fringe of the scheme making use of excess water from scheme.

The scenario presented above calls for the redesign of the irrigation structure in the scheme. The work will involve the rehabilitation of the first intake, construction and extension of the second intake to cover more irrigation land. The process will improve the scheme efficiency and productivity for improved food security and economic empowerment. The GoK requirement for project implementation is to conduct EIA. Creation of Environmental Impact Assessment (EIA) system is vital to conform socio-economic development projects to environmental safety and thereby ensure sustainable economic development. It helps the planning and management to take long-term measures for effective management as well as environment conservation.

1.2 Purpose and objectives of the exercise

The purpose of this exercise is to carry out an Environmental Impact Assessment and associated studies for the proposed Gem Rae Irrigation infrastructure as per the guidelines of the EMCA 1999, EMCA (Amendment) 2015, and the Environmental (Impact Assessment and Audit) Regulations 2003 as well as other statutory requirements including international best practice.

The specific objectives

- a) To identify the anticipated environmental impacts (biophysical, chemical) of the proposed facility and the scale of the impacts;
- b) To identify and analyze alternatives to the proposed infrastructure;
- c) To propose mitigation measures to be taken during and after the implementation of the infrastructure; and

- d) To develop an environmental management plan with mechanisms for monitoring and evaluating the compliance and environmental performance which shall include the cost of mitigation measures and the time frame of implementing the measures?

1.3 Project justification

Irrigation is the applications are often the most cost-efficient way to increase agricultural productivity, especially in areas with large open spaces. Irrigation helps to grow agricultural crops, maintain landscapes, and re-vegetate disturbed soils in dry areas and during periods of less than average rainfall. The proposed site was designed to irrigate 350 hectares of rice. Currently, the area under irrigation is approximately 90 ha and rehabilitation and extension of infrastructures will ensure enhanced rice productivity food security and economic empowerment. Other studies indicated that irrigation projects have been successful in enabling farmers to obtain a certain amount of wealth, This proposed site where scheme is located is an open place and some distance from residential homes and this make it not to present negative impact to the community.

1.4 Scope

The Environmental Impact Assessment was conducted at the site and the surrounding area. The assessment involved the physical examination, interviews with beneficiaries, neighboring communities, relevant consultants and government agencies.

To generate environmental impacts assessment study report for submission, it involved a systematic examination of all proposed activities.

The project assessment investigates and analyses the anticipated environmental impacts of the proposed development in line with the Environmental (Impact Assessment and Audit) Regulations of 2003.

Consequently, the report will generate the following:

- Nature of the project
- The location of the project including the physical area that may be affected by the project activities
- The activities that shall be undertaken during the project phases
- The potential environmental impact of the project and mitigation measures to be undertaken during and after the project cycle
- An action plan for prevention and management of possible accidents during the project cycle
- A plan to ensure that the health and safety of the workers and the neighbouring communities
- Any other information that the proponent may be requested to provide by NEMA

1.5 Criteria

The environmental impact assessment was carried out in line with the environmental management, statutory and regulatory requirements in Kenya as outlined in section two of this report, the

Environmental (Impact Assessment and Audit) Regulations 2003 and best practice guidelines on safety and health as per the Occupation Safety and Health Act, 2007.

Following the preliminary visit of the proposed site, the following was undertaken

- Screening of the project, a process that identified the project as being among those that requiring EIA under schedule 2 of the EMCA 1999
- A scoping exercise that identified the key issues to be identified in the study
- Documentary review on the nature of the proposed activities, policy and legal framework, environmental setting of the area and other available relevant data/information
- Detailed discussions with the proponent and the consultation with the relevant officials in the regulatory authorities
- Physical investigation of the site and the surrounding areas using a pre-prepared checklist identifying possible environmental and human safety issues that are likely to be affected
- Reviewing the proposed project designs and implementation plan/schedules with a view to suggesting suitable alternatives
- Developing an environmental management plan with responsibilities, schedules, monitorable indicators and time frame among other aspects
- A comprehensive report including all issues as listed in the Environmental (Impact assessment and audit) Regulations 2003.

1.6 This Report

In the introduction (Chapter One), the report highlights a brief description of the project background, objectives and project identification/justification.

The views and recommendations from the area residents as well as other stakeholders have been highlighted in Chapter Two. The methodology used in conducting this EIA has also been presented in chapter Two.

The legal framework against which the project must comply has been reviewed in Chapter Three. The pertinent statutes which have been reviewed include the EMCA, EIA/Audit Regulations, Water Act, Public Health Act, Factories and other places of Work Act, Physical Planning Act, etc.

The Project's baseline characteristics have been documented in Chapter Four for the purpose of providing data against which the project monitoring may be carried out in the future. Information in this chapter touches briefly on climate, water resources, topography, land tenure and land use, infrastructural situation, social economic setting, as well as the population profiles of the project area.

Chapter Five, activities and anticipated impacts to be encountered during the project construction phase. The Chapters also highlights the expected by-products and the method of waste disposal as

well as the decommissioning plan. The chapter also highlights environmental impacts and their mitigations. The chapter highlights the project alternatives. The idea is to compare the proposed dumpsite with other project alternatives i.e. choosing other sites or getting other means for waste management.

Chapter six identified mitigation and monitoring strategies, an Environmental Management and Monitoring Plan (EMMP) has been developed and is presented in Chapter Ten. It dwells on the various environmental management strategies and procedures and identifies the institutional management roles and responsibilities. It ensures that monitoring is undertaken and that the results are analysed during all phases of the project.

Finally, Chapter seven covers the conclusion and recommendations of this EIA report.

CHAPTER TWO: METHODOLOGY, PUBLIC CONSULTATION AND ANALYSIS OF ALTERNATIVES

This study was carried out through desk reviews and field investigations including public consultations. The consultant conducted extensive literature review pertaining to suitability of the site to the project. During the field investigation, reconnaissance survey was conducted to gather information on biophysical and socio economic aspects of the area and its environs. In order to address these issues the study team adopted a participatory approach where the immediate surrounding communities were consulted in addition to reviews and references to sources of information including legal statutes, design and relevant project documents.

2.1 EIA Process

Due to the extensive nature of the EIA process, it was necessary to commence the process early during the project cycle. The process was initiated at the stage of feasibility study. The stages of the EIA process are summarized in the following sections.

2.1.1 Scoping

Scoping is the process of brainstorming on the issues and alternatives that need to be considered in the EIA process. It helps to determine which impacts are likely to be significant and thus require more focus in the EIA process. This is a valuable step at the start of the EIA process and as part of the EIA Study Report development, as it can mitigate against unexpected issues arising later in the project. The scoping analysis also helps to inform on data availability and gaps, determine the appropriate scope of the assessment, suggest suitable survey and research methodologies and help to eliminate issues that could otherwise consume time and resources to investigate.

The scoping process involved discussions with the project proponent and desk review of existing project reports, plans and site assessment by the EIA study team.

2.1.2 Analysis of Potential Impacts

The scoping process of the EIA was followed by the analysis of the potential impacts. This involved analysing the potential impacts identified during scoping to determine their exact nature, scale, magnitude, likelihood, extent, effect as well as possibility for reversibility. This analysis promotes better understanding of the potential impacts and provides information on whether the impact is positive or negative and, if negative, whether it is acceptable, requires mitigation or is not acceptable. In addition, this analysis helped in distinguishing primary and secondary impacts.

The impacts will be both primary and secondary primary impacts are those typically associated with construction, operation and maintenance of the infrastructure and are generally more obvious and easy to quantify. Secondary impacts are those that are induced by the project or the primary impacts. These impacts can be negative as well as positive. In this study, the following were identified as potential primary and secondary impacts:

The expansion and intensification of Gam Rae Irrigation Scheme has the potential for causing:

- Increased erosion;
- Pollution of surface water and groundwater from agricultural biocides;
- Deterioration of water quality
- Increased nutrient levels in the irrigation and drainage water resulting in algal blooms,
- Proliferation of aquatic weeds and eutrophication in irrigation canals and downstream waterways.
- Poor water quality below an irrigation project may render the water unfit for other users,
- Harm aquatic species and, because of high nutrient content, result in aquatic weed growth that obstructs waterways and has health, navigation and ecological consequences.
- Elimination of dry season die-back and the creation of a more humid microclimate may result in an increase of agricultural pests and plant diseases.
- Large irrigation projects which impound or divert river water have the potential to cause major changes in the hydrology and limnology of river basins.
- Reducing the river flow changes flood plain land use and ecology and can cause salt water intrusion in the river and into the groundwater of adjacent lands.
- Diversion of water through irrigation further reduces the water supply for downstream users,
- Waterlogging and salinization of soils,
- Increased incidence of water-borne and water-related diseases,
- Problems of resettlement or changes in the lifestyle of local populations.

The potential impacts were considered for the different stages of the project (site investigations, construction, operation and maintenance). This information was used to identify the mitigation measures and attribute responsibility in the mitigation plan.

2.1.3 Identification of Mitigation Measures

The analysis of potential positive and negative impacts was then followed by the identification of mitigation measures to address the potential negative impacts. The aim of mitigation is to either eliminate or reduce negative impacts. Some of the mitigation options include; avoidance of impact, reduction of impact and restoration to original state.

2.1.4 Analysis of Alternatives

After the analysis of potential impacts and the identification of mitigation measures, analysis of options and alternative ways to meet the same objectives was considered with an aim to identify the least damaging option. At this point, comparison of potential impacts and mitigation options were made against a series of alternative designs, locations, technologies and operation so as to identify the most desirable combination. The process was guided by clearly articulated project objectives so that the analysis of alternatives does not digress into the consideration of irrelevant options.

In this case, analysis of alternatives included the following considerations:

- 1) **Different location.** While this issue is mainly of particular importance where there are cultural or special habitats that should be protected, where a particular location might increase the likelihood of conflicts (e.g. over water scarcity pasture or between domestic users and livestock/wildlife) or increase the likelihood of environmental degradation for example by attracting more wildlife than the environment can sustain, in this case the listed factors do not apply as the proposed site is whole within gazetted land;
- 2) **Different design.** This involved considering different ways (in terms of technology or structure) of irrigation infrastructure design using alternative means;
- 3) **Different way to meet same objective.** This included consideration of alternative sites and modification and initiation of new sites however the expansion existing scheme is the most economical way.
- 4) **No project option.** This option essentially provides a basis of comparison with the proposed project and other alternatives. The no-project option is not necessarily a static situation as external factors such as need for food security, employment and livelihoods are dynamic.

2.1.5 Environmental Management and Monitoring Plan

The Environmental Management and Monitoring Plan (EMMP) sets out the indicators, timeframe, cost and responsibility for the management of the impacts and implementation of the mitigation measures. The EMMP is elaborated to sufficient detail to address the identified adverse impacts. Some of the areas that have been covered in the EMMP include but are not limited to: Description of prioritized mitigation activities, timelines and resources to ensure delivery of the EMMP, a communication plan as well as monitoring strategies.

2.1.6 Decommissioning Plan

Decommissioning of a small scale irrigation scheme site can arise for a number of reasons which may include:

- The infrastructures has been filled with sediment or for whatever reason cannot provide the stream of benefits for which it was constructed;
- The scheme has become an uncontrolled public safety hazard. This could arise if proper maintenance of the intakes are neglected by the management and NEMA decides to withdraw the permit;
- The management of the infrastructures decides to decommission the structure.

Decommissioning a infrastructures does not necessarily mean removing the infrastructures because the process of decommissioning may cause negative environmental and/or social impacts. Decommissioning implies making the scheme safe through a process of analysis of the options and impacts, and establishing a decommissioning plan that aims to secure the best long term beneficial impacts to both the social and bio-physical environment.

In the event that the removal of the infrastructure is inevitable, then breaching, in the case of the scheme, may be considered. Gradual removal of the water should be done carefully to avoid any ecology and limnology of the river suffers adverse effect.

2.2 Public Consultation, Disclosure and Participation in the EIA Process

2.2.1 Public Disclosure and Consultation

Public disclosure and consultation is a regulatory requirement but experience has also proven that it adds value to the project and helps mitigate future conflicts and negative impacts.

Public disclosure and consultation is particularly important during the EIA process firstly because completion of most EIA processes demand it and cannot be said to have effectively occurred without it and secondly because the EIA process begins at the initial stages of the project and thus provides a great opportunity to set the pace on public disclosure and consultation and win the trust and collaboration of stakeholders.

Relevant plans for public disclosure and consultation must therefore form part of the EIA process. It is important that the disclosure process provides time and resources to ensure that the affected communities have an opportunity to understand the implication of potential social and environmental impacts. An individual impact may cause a cascade of other secondary impacts and it is this association of cause, effect and impacts that should be fully disclosed.

2.2.2 Stakeholder Analysis and Consultation

Stakeholder analysis is the process of identifying interested and affected parties and considering how best to consult with these parties. The outcome should be a Stakeholder Engagement Plan

(SEP) that documents who, how and when stakeholders will be consulted regarding what aspects of the project throughout the various stages of the project.

The goal of stakeholder engagement during the EIA process is to engage with interested and affected stakeholders in order to provide accurate and timely information on the merits and demerits of the proposed water conservation structure, facilitate discussions to register comments and concerns, and enable stakeholders to participate meaningfully in the EIA process. The expected outcome of this engagement is a well-informed body of stakeholders, including the project proponent, with an understanding of the potential benefits and impacts of the project, where concerns that they raised have also been addressed. The support of stakeholders provides the project with the social license for project implementation.

2.2.3 Methodology for Stakeholder Engagement

The consultant used participatory methodologies which included:

1. Public meeting (baraza). This is appropriate for reaching a larger number of people.

1 Adequate attention was given to announcing the intended meeting. The meeting was coordinated and announced through the Area Chief assisted by the Assistant Chiefs of the area. The approach adopted by the Area Chief was notices channeled through the local day schools, local churches, local CBOs, and through mobile technology.

2. Key informant interviews. These are one-on-one interviews with key informants like local leaders, thematic experts, and individuals who are likely to be directly affected by the project;

3. Focus Group Discussions. This approach was adopted in discussion with County Government of Kisumu employees and local opinion leaders. It provided an environment in which group members could speak more freely and discuss internally to formulate and voice an opinion that perhaps could not be discussed in a public baraza.

An important part of the stakeholder consultation process is the documentation of who was consulted, what was disclosed, and what opinions were expressed. The following documentation has been submitted to substantiate that public consultation was conducted:

- Signed participation lists from public meetings and focus group discussions;
- Minutes of meetings;
- Signed key informant forms which document the opinions of the informant; • Copy of materials that were discussed or shared with the public and stakeholders;
- Photographs.

2.3 Data Collection Procedures

A three-stage process essentially covered the development of this EIA Project report:

- Literature review of relevant documents;
- Site reconnaissance to the proposed Gem Rae irrigation scheme Project; • Consultations with the project proponent; and consultation with relevant stakeholders' i.e. downstream area residents, neighbouring institutions and government agencies and representatives.

Data collection was carried out using checklists, questionnaires, individual and group interviews, observations and photography, as further described below.

2.3.1 Desk Study

This included documentary review on the nature of the proposed activities, project documents, project design documents including layouts and profiles, and relevant legislative and regulatory frameworks among others.

2.3.2 Public Consultations and Disclosure

It is incumbent on the project proponent to disclose the nature and scope of the project so that the public can be fully informed and provided with an opportunity to consider the potential impacts of the projects. The public disclosure and consultation process has been designed to help the public and interested stakeholders to understand the project and document their concerns. These concerns can then be addressed through the design of the project's environmental monitoring and mitigation plan.

The public's interest in the Gem Rae Irrigation Scheme infrastructure installment Project is foreseen to arise as a result of the possibility of unknown or unforeseen effects being occasioned by the project along with the risk of aggravation of any existing water use conflicts.

Taking cognizance of the fact that public participation is a right enshrined in the Kenyan Constitution and the important role that public consultations and disclosure plays in promoting acceptability of a project, identifying possible effects of the project as well as availing critical information for the design of the project to mitigate any possible effects, the project proponent has undertaken public and stakeholder consultations through a team of EIA Consultants. The Consultant EIA field team carried out stakeholder consultations in order to determine whether the downstream area residents, and surrounding community and other interested parties were aware of the proposed project, had any issues of concern related to the proposed project and if they were in support or opposing the project.

The methodology for consultations used was preceded by making preliminary site visits on the proposed irrigation site and discussions with the proponents by the EIA Lead Expert so as to aid in the structuring of the questionnaires and identify the key stakeholders. This preliminary site visits were made between October and November 2019.

After this, questionnaires were designed to capture both the interested and affected parties who include the general public in the nearby villages and the major stakeholders (key informants).

The questionnaires were designed to capture information on whether the proposed development will have significant impacts on the following:

- Local residents/neighbours;
- Natural ecology of the area;
- Recreation and aesthetic values;
- Public health and safety;
- Effect on water resources and quality;
- Effect on soils;
- Effect on infrastructural facilities;
- Effect on socio-economic aspects; • Effects on agricultural activities; and
- Effects on security.

The EIA team then carried out both individual and public consultations on 2nd, 3rd and 4th October, 2019. The discussions on the proposed project during these consultations focused on, but were not limited to:

- Background of the proposed project and what exactly the project will entail;
- Potential positive and negative impacts of the projects;
- Stakeholders views and feedback on the proposed project;
- Stakeholders support to the proposed project;

During these consultations, the stakeholders got a clear understanding of the proposed project following necessary briefing by the EIA field team. This information helped in assessing the impact of the project on the environment as well as on the social economic status of the area residents.

Key informants who gave their views during the main consultations included:

Serial no.	Name	Gender	Village
1.	Charles Ambugo	Male	Koloo
2.	Alex Ajowi	Male	Koloo
3.	Maurice Omware	Male	Koloo
4.	Gladys Agembo	Female	Kosano
5.	Carren Odingo	Female	Koloo
6.	Leonard Lusi	Male	Kanyikwaya
7.	Wilson Ondiala	Male	Kosano

8.	Sospeter Amilo	Male	Koloo
9.	Charles Awino	Male	Kanyikwaya
10.	David Arach	Male	Kosano
11.	Joseph Sikuku Otwo	Male	Koloo
12.	Joyce Ayodo	Female	Kanyikwaya

2.4 Analysis of Questionnaires & Feedback from the Public Baraza

Ten key stakeholders were identified and questionnaires admitted to them. Analysis of the comments in the questionnaire indicates that all the key stakeholders support the project. The identified potential negative impacts highlighted by the key stakeholders for which mitigation measures need to be provided include:

- Accidents, noise pollution during construction phase
- Accidents, specifically drowning in the operational phase.

On the other hand the key stakeholders stated the potential project benefits as follows:

- Creation of employment
- Flood control especially in the downstream farms
- Increased water supply

2.5 EIA Team composition

Serial no.	Name	Gender
1.	Dr. Walter Alando	Environmental Expert
2.	Eng. Felix Odongo	Engineer
3.	George O. Anyona	Hydrologist
4.	Walter O. Odera	Social Scientist

CHAPTER THREE: POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This Chapter summarizes the relevant policies, legal and institutional frameworks that have a bearing on the proposed small irrigation scheme within Nyando Sub County in Kisumu County. It is a requirement that the proponent complies with the following policies and laws.

3.1 Introduction

The Environmental Impact Assessment is a useful tool for protection of the environment from the negative effects of developmental activities. It is now accepted that development projects must be

economically viable, socially acceptable and environmentally sound. It is a condition of the Kenya Government for developers to conduct Environmental Impact Assessment on the development Projects.

There is an existing policy, legal and administrative framework regulating the proposed project. The government has established regulation to facilitate the process of EIA study and EA. The regulations are contained in the Kenya Gazette supplement No. 56, legislative No. 31, legal notice No. 101 of 13th June 2003. In addition, the government has a number of National Policies and statutes to enhance environment and sustainable development. Some of the policies and legal provisions are discussed below.

3.2 Policies

Both the development and environment policies are being formulated by the respective ministries in consultation with relevant stakeholders. Government intentions in reducing air emissions has been on the rise ever since through initiatives of tree planting. This target will be realized through investments by government, private sector, civil society and individuals.

Environmental Impact Assessment (EIA) is a methodology used to identify the actual and probable impacts of the projects and programs on the environment and to recommend alternatives and mitigating measures. The assessment is required at all stages of project development with a view to ensuring environmentally sustainable development for both existing and proposed public and private sector development ventures. The National EIA regulations were issued in accordance with the provisions of Environmental Management and Co-ordination Act (EMCA) of 1999. The EIA Regulations must be administered, taking into cognizance provisions of EMCA 1999 and other relevant national laws. The intention is to approve and license only those projects that take into consideration all aspects of concern to the public as they impact on health and the quality of the environment.

3.2.1 National Environmental Action Plan (NEAP)

The NEAP for Kenya was prepared in mid 1990s: It was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multisectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources are an integral part of societal decision making

3.2.2 The National Poverty Eradication Plan (NPEP)

The NPEP has the objective of reducing the incidence of poverty in both rural and urban areas by 50 percent by the year 2015; as well as the capabilities of the poor and vulnerable groups to earn income. It also aims to narrow gender and geographical disparities and a healthy, better educated and more productive population. This plan has been prepared in line with the goals and commitments of the World Summit for the Sustainable Development (WSSD) of 1995. The plan focuses on four WSSD themes of the poverty eradication; reduction of unemployment; social

integration of the disadvantaged people and the creation of an enabling economic, political, and cultural environment. This plan is to be implemented by the Poverty Eradication Commission (PEC) formed in collaboration with Government Ministries, community based organizations and private sector.

3.2.3 National Policy on Water and Resources Management and Development (NWRMD)

While the National Policy on water resource management and development (1999) seeks to enhance systematic development of facilities in all sectors for the promotion of the country's socio-economic progress, it also recognizes the by-product of this process as wastewater. It, therefore, calls development of appropriate sanitation systems to protect people's health and water resource from any source of pollution.

Industrial and business development activities therefore should be accompanied by corresponding waste management systems to handle the waste water and other wastes emanating from such processes. The same project requires that such projects should also undergo comprehensive EIA studies that provide sustainable measures to be taken to ensure environmental resources and people's health in the immediate neighborhood and further downstream are not impacted by the emissions. As a follow-up to this, EMCA 1999 requires annual environmental audits to be conducted in order to ensure that mitigation measures and other improvements identified during EIA study are implemented.

In addition, the policy provides charging levies on waste on basis of quantity and quality. The polluter-pays- principle applies in which case parties contaminating water are required to meet the appropriate cost of remediation. The policy provides for establishment of standards to protect water bodies receiving waste water, a process that culminated in the enactment of the environment Management and Coordination (Waste Management) Regulations 2006.

The key objectives of the policy include:

- To ensure that from the onset, all development policies, programs and projects takes environmental consideration into account.
- To ensure that independent environmental impact assessment (EIA) report prepared for any industrial venture or other development before implementation
- To come up with effluent treatment standards that will conform to acceptable guidelines. This has already been done by NEMA through the Environmental Management and Coordination (Waste Management) Regulations 2006, and environmental Management and Coordination (water Quality) Regulations 2006.

a) EMCA requirements for Environmental Impact Assessment and Audit

The Act aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective

management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with national objectives and the sustainable development goals enunciated in Agenda 21 of the Earth Summit held in Rio de Janeiro in 1992. The ultimate objective is to provide a framework for integrating environmental considerations into the country's overall economic and social development.

The second schedule of the Act lists the projects for which an EIA and/or EA must be carried out. Section 68 of the Act specifies that accurate records should be maintained and annual reports submitted to NEMA, as required.

This project report has been undertaken in accordance with the Environment (Impact Assessment and Audit) regulation 2003, which operationalize the Environment Management and Coordination Act EMCA) 1999. The report is prepared in conformity with the requirements stipulated in the (EMCA) and the Environmental Impact Assessment and Audit regulations 2003 regulation⁷ (1) and the second schedule. Part II of the said act states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. In order to achieve the goal of a clean environment for all, new projects listed under the second schedule of Section 58 of EMCA No 8 Of 1999 shall undergo an environmental impact assessment. This includes development activities such as the installation of this new incineration plant. In addition to the legal compliance above, the following legal aspects have also have been taken into consideration

b) The Environment Impact (Assessment and Auditing) Regulations, 2003

Legal Notice No. 101 stipulates the ways in which environmental experts should conduct Environmental Impact Assessment and Audits in conformity with the stated requirements. It is concise in its report content requirements, processes of public participation, licensing procedures, inspections and any possible offences under the Act.

c) Environmental Management and Coordination (Waste Management) Regulation 2006

The Legal Notice No. 121 stipulates the responsibility of any waste producer. Part II section one states that: No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. And that; any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed of such waste in the manner provided for under these Regulations¹. Subsection three of Part II highlights the way waste should be handles stating that, any person whose activities generates waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose of such waste in a designated waste disposal facility

d) Water Quality and Waste Management Regulations 20006

The regulations were gazetted in September 2006 and come into force in 1st April, 2007. The regulation details the waste management requirements and also requires application of a license to all those premises discharging the waste to the environment.

The County Government Act No. 17 of 2012

Under the new constitution of Kenya, County Governments have taken over what used to be previously the functions of County authorities. The act has given power to the County government to control or prohibit all developments, businesses, factories and other activities. This include any proposed project which, by reason of smoke, fumes, gases, dust, noise or other cause may be or become a source of danger, discomfort or annoyance to the neighborhood, and to prescribe conditions subject to which such business, factories, yards etc. shall be carried. The new constitution grants county governments the powers to grant or to renew business licenses or to refuse the same. The maintenance of health, safety and wellbeing of the inhabitants of its area. This includes construction and maintenance of water supply, sewage and solid waste management systems.

The proponent has applied for approvals from the County Government of Kisumu to commence the development.

To ensure implementation of the provisions of the new constitution, the county governments are empowered to make by-laws in respect of all such matters as are necessary or desirable for

3.2.3 The Water Act 2002

The purpose of the Water Act is to provide the management, conservation and use and control of water resources and for the acquisition and regulations of use of water, to provide for the regulation and management of water supply and sewerage supply. Except for waters that are wholly situated in a private landowner's domain, the act vests the right over all surface and ground water in the state. This is only subject to the rights which users may acquire under license from time to time.

The overall power for the control for the control of every body of water is exercised by the minister. The minister has the duty to promote the investigation, conservation and proper use of water resources throughout Kenya.

The act provides for a water resource management authority whose functions include, inter-alia, developed principles and procedures for allocation for water resources, monitor national water resource management strategy, determine applications for permits for water use, regulate and protect water resources quality from adverse impacts, manage and protect water catchments, e.t.c. In addition, under the water (catchments board) rules promulgated by the minister, the country is divided into six catchment boards, vis-avis Tana Catchments board, Rift Valley

Catchment's Board, Athi River Catchment's Board, Ewaso-Nyiro Catchment's Board, Lake Victoria (North) Catchment's Board and Lake Victoria (South) Catchment's Board. But these boundaries are subject to variation depending on available hydrological information.

Under the act, the minister may declare an area to be a conservation area and direct that special measures be taken for the conservation for the ground water therein. Every person who has been using ground water in an area declared to be a conservation area and who desires to continue with the use must obtain a permit within six months of the order. It's an offence to disobey such an order.

Protection of water supply is clearly a critical issue under the act. Accordingly, whenever the minister is satisfied that special measures are necessary for the protection of a catchment area from each quarter is obtained; he may declare such an area to be a protected area. By order, the minister may regulate or prohibit the activities within that area which may be contrite to the requisite conservation goals.

An in-depth analysis of the new water Act reveals that the Act has created an integrated water resources management framework in Kenya which is participatory and likely to have a wider acceptance and implementation than the predecessors. Part II, section 18 of the act provides for the National monitoring and information systems on water resources. Following on this, subsection 3, allows the water resource management authority to demand from any person or institution specified information documents samples or materials on water resources. Under these rules, specified information document, samples or materials on water resources may be kept by a water user and the information thereof furnished by the authority.

Section 73 of the Act allows a person with a license (licensee) to supply water and make regulations for purposes of protecting against degradation of water resources. Section 75 and Sub-section 1 allows the licensee to construct and maintain drains, sewers and other works for intercepting, treating or disposing any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

Section 94 of the Act makes it an offense through or convey or cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive or unwholesome matter or thing into or near to water resources in such a manner as to cause or be likely to cause pollution of water resource.

Section 23 indicates that the authority shall approve community projects after they are approved by the persons owning or occupying at least two thirds of the particular area concerned in the project and that provision is made by the project for an adequate alternative supply of water when and if the available levels to other users is.

It also prohibits cancellation of a permit of a community project without the consent of the minister.

Section 24 requires all beneficiaries of a community project whose construction is funded in full or in part by the government, if the minister so determines, to pay a rate or charge for that benefit.

3.2.4 The Public Health Act cap 242

Part IX, Section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116, requires local authorities to take all lawful, necessary and reasonable practicable measures to maintain areas under their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health.

Such nuisance or conditions are defined under section 188 wastes, sewers, drains or refuse pits in such estate, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to human health. Noxious matter or waste flowing or discharged from any projects into a public street or into the gutter or side chanel or watercourse, irrigation channel or bed not approved for discharge is also deemed as a nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of medical officer of health is likely to harbor rats or other vermin.

On the responsibility of local authorities, Part XI section 129 of the Act states in part —it shall be the duty of every local authority to take all lawful, necessary and reasonable practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes

Part XII section 136 states that all collection water, sewage, rubbish, refuse and other fluids which permits or facilitates the breeding or multiplication of pests shall be deemed nuisance and are liable to be dealt with in the manor provided by this act.

3.2.5 The Physical Planning Act, Cap 286

The local Authorities are empowered under section 29 of the act to serve and maintain all land planned for open spaces, parks, urban forests and green belts, the same section therefore, allows for prohibition or control of the use and development of land and building in the interest of proper and orderly development of an area.

Section 30 states that any person who carries out development without permission will be required the land to its original state. It also states that NO licensing Authority shall grant land license for commercial or industrial use or occupational or any building without development permission granted by the respective local authority.

Finally, section 36 states that if in connection with a development application, local authorities is of the opinion that that the proposed development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application of the environmental impact assessment (EIA) report. EMCA, 1999 echoes the same by requiring that

such an EIA is approved by the National Environmental Management Authority (NEMA) and should be followed by annual environmental Audits.

3.2.6 The penal Code Cap 63

Section 193 of the code states that any person or institution that voluntarily corrupts or foils water for public springs or reservoir, rendering it less fit for its ordinary use is equally of an offence.

Section 192 of the same act states that a person who makes or vitiates the same atmosphere in any space to make it noxious of health of a person/institution in dwellings or projects in the neighborhood or those passing along public way commits an offence

3.2.7 Occupational Safety and Health Act (OSHA) 2007

The Act requires all employers to register their workplaces by making an application to the Director of Occupational Health and Safety Services before they start any operations. The Act also sets minimum standards that are to be maintained in such workplaces to safeguard health, safety and welfare of workers. These are all aimed at elimination of hazardous wastes from workplaces. The act also requires that all workplaces to display the abstract of the act for all workers to read and remind themselves on how to protect themselves from hazard.

The act and its subsidiary legislation makes provision for health, safety and welfare persons employed in factories and other places of work such as in building construction and project operations are defined. The act prohibits emissions of dust, fumes or impurities into the atmosphere without proper treatment to prevent pollution or other ill effects to life and property. These provisions require that all practical measures taken to protect all persons employed in a factory from air emission or impurities originating from any process within the factory.

The act also requires that no discharges should be made into the environment from factories and workplaces without proper treatment that requires them harmless to the environment.

The act also has specific measures that need to be taken to protect health, safety and welfare of workers and environmental conservation. The same act also requires all operation that fall under it to apply for registration as such to the Directorate of Occupational Health and Safety Services.

3.3 Legal Aspects

The key National laws that govern the management of environmental resources in the country have been briefly discussed in the paragraph below. Note that whenever any of the laws contradict each other, the environmental management and coordination act prevails

3.3.1 The Environmental Management and Coordination Act, 1999 a) Background and administrative Structures

The environment Management and Coordination Act of 1999 received a presidential assent on January 6th, 2000 and was gazetted on January 14th, 2000. The main objectives of the act are:

- Provide guidelines for the establishment of a legal and institutional framework for the management of environment in Kenya
- Provide a framework of legislation for over 77 statutes in Kenya that contain environmental provisions
- Provide guideline for environmental impact assessment, environmental audit and monitoring, environmental quality standards and environmental protection orders

In 2001, the government established the administrative structure to implement the act. The two main administrative structures are:

i. The National Environmental Council (NEC)

The National Environmental Council (the council) is responsible for policy formulation and directions for the purpose of the Act. The Council also sets national goal and objectives and determines policies and determines policies and priorities for the protection of the environmental.

ii. The National Environment Management Authority (NEMA)

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

In addition to NEMA, the act provides for the establishment and enforcement of environmental quality standards to be set by the technical committee of NEMA known as the standards and Enforcement review Committee (SERC).

3.3.6.1 Safety and Health Committee Rules of 2004

The rule states that any employer/proponent/occupier who employs more than twenty persons must establish a committee to address health, safety and welfare of workers. The employer must also cause to be carried out a health and safety audit of all its operations in an annual basis by a registered health and safety advisor who should forward such a report to the Directorate of Occupational Health and Safety Services.

3.3.6.2 First Aid Rules

These have details on first aid requirements in terms of facilities and capacity building among residential workers.

3.3.6.3 Hazardous Substances Rules

These regulate the handling, transportation and use of certain listed chemicals which may have negative effects on the body when one is expected.

3.3.6.4 Noise Prevention and Control Rules of 2005

These rules have set minimum and maximum exposure limits beyond which workers and members of the public should not be exposed to noise without adequate means of protection. The rules also

have exposure limits for exposure out of workplaces. The rules have several recommendations on a comprehensive noise control program for workplaces that includes a requirement for medical examination of workers who are exposed to noise. The rules have also set the minimum noise levels that should emanate from a facility to public/neighboring areas by day or by night.

First Schedule to the Regulations as shown in the Table below:

Table 4.1 Maximum permissible noise levels

ZONE		Sound Level Limits dB(A) (Leq,14 h)		Noise Rating Level (NR) (Leq,14 h)	
A	Silent Zone	40	35	30	25
B	Places of worship	40	35	30	25
C	Residential :	45	35	35	25
	Indoor	50	35	40	25
	Outdoor				
D	Mixed residential (with some commercial and places of entertainment)	55	35	50	25
E	Commercial	60	35	55	25

3.3.2 Building Operations and Works of Engineering Rules

The rules guide health and safety matters in all building/construction and civil engineering works

These rules state clearly that it is the duty of the proponent to ensure health, safety and welfare of all workers and authorized visitors to the site before commencement of operations, the proponent should notify the Director of Occupational Health and Safety Services of the intention so that from then on, the director advises and follows up on the necessary conditions to safeguard the health, safety and welfare of workers on site.

The rules also state that qualified and experienced persons must be appointed to act as safety supervisors by the proponent. These should supervise the enforcement of the standards to achieve the objectives mentioned above.

The rules have specific sections on excavation, transport, demolition, formwork and scaffolds, lifting and lifting equipment and other safety measures.

CHAPTER FOUR: BASELINE ENVIRONMENTAL CONDITIONS AND PROJECT DESCRIPTION

The location and the environment in which the project will be working in are outlined below.

4.1 Location and historic background

Gem Rae is a rice-growing scheme close to Lake Victoria, about 30 km from Kisumu, Nyanza Province, Kenya. The water source for the scheme is the River Awach. Topography across the scheme is flat with an average gradient of about 0.5% and prior to irrigation the area was mainly swamp land prone to flooding. The prevailing soils across the scheme are medium to heavy, dark grey or black clays suitable for rice cultivation. The current irrigated area is approximately 90 ha with a total of 270 plots averaging 0.3 ha. There are 230 land-owners. A further 28 ha are occupied by out growers on the fringe of the scheme, making use of excess water from Gem Rae and flow in the river downstream of the intake.

Rice cultivation in the area began in 1938 using simple check structures and flood irrigation along the river. However, the meandering nature of the river and erosion meant that by the early 1980's this type of irrigation was impossible. Following a request to the Provincial Irrigation Unit (PIU), rehabilitation of Gem Rae commenced in 1984. The first irrigation was supplied in 1986. Funding for this work was provided by the Kenyan and Dutch governments as part of the Smallholder Irrigation Development Project (SIDP).

4.1.1 Climate

Gem Rae is in the Lower Midlands agro-ecological zone classified as "humid/arid". Annual precipitation is 1250 mm with peaks in April and November. The rainfall pattern is unpredictable, however, with monthly maxima typically two or three times the mean. During the study year (1990s) total rainfall was only 840 mm. Temperatures are fairly constant throughout the year with monthly average maxima ranging from 25°C to 35°C. Reference evapotranspiration varies from about 4.5 mm/day in November to 6.2 mm/day in March, equating to an annual evapotranspiration of 1800 mm.

4.1.2 Farming activities

Rice is grown exclusively at Gem Rae. One crop is grown per year, land preparation theoretically starting in June. Grain is harvested in December. For the remainder of the year farmers grow maize, the local subsistence crop, and sorghum under rain-fed conditions outside the scheme boundary. Land within the scheme is used for grazing during this period.

4.1.3 Scheme characteristics

The intake to Gem Rae is formed by a gabion weir across the River Awach with a gated culvert leading to the main canal whose total length is 2.4 km. The system consists of the main canal, which also serves the neighbouring scheme, three secondary canals and nine tertiaries. Tertiary canals are spaced at about 200 m intervals along the secondaries and serve between 3 and 15 ha. Flow is continuous to all canals.

Division of water is achieved with eleven proportional division boxes constructed of concrete blocks. No manual control of flow is possible; division is according to relative crest lengths. Basin irrigation is practiced, each plot being divided into a number of basins varying in size from about 10 m by 10 m to 50 m by 50 m. Water passes from the tertiary canals and then from plot to plot on a 24 hour basis. Average ponded depth is about 10 cm. Design calculations assumed an average evapotranspiration rate of 6 mm/day, an infield efficiency of 60% and total canal losses of 10%. Thus the design flow was calculated as 1.5 l/s/ha with a maximum of 3 l/s/ha for land preparation.

Operation and management of Gem Rae is carried out wholly by the farmers' committee with advice from the local extension officer. The committee used to consist of 24 members and meets at the beginning and end of each season. Farmers are divided into groups sharing a common tertiary canal, giving a maximum group size of about 40 farmers. Responsibility for maintenance of the main and secondary canals rests with the whole scheme whilst each group of farmers is responsible for its own tertiary canal.

4.2 Infrastructural Situation

4.2.1 Transport network

The main road passing network is tarmacked connecting Ahero junction to Katito. There are adequate public service vehicles on this road. However, motorbike taxis are also common on this road. The access road inside project site has not been graded by the project proponent and is still not in a good condition.

4.2.2 Information communication technology (ICT), telecommunications and Energy

The area is well covered by Safaricom, Telcom and Airtel Signals. There is also electricity supply by the Kenya Power and Lighting Company in the area.

4.3 Population and Education

4.3.1 Population

The scheme falls within Nyando Sub County that has population of 141 037 individuals. The scheme consists of 250 households that translate to 15,000 individuals. The population concentration is mainly around the scheme on the Eastern side.

4.3.2 Education

There exists a primary and day secondary school in the area. There is also a ECD centre. Sixty-six out of the one hundred and nineteen farmers interviewed (55.0%) had at least primary level of education and another twenty-two farmers (18.5%) had secondary school level of education. Those with secondary level of education and above were 21.9%. The farmers with high level of education are expected to have high intellectual capacity.

4.4 Sanitation Facilities and irrigation water

Households around the project area use pit latrines for human waste disposal. It was noted that Ayweyo chogo entre is next to the proposed site.

4.5 Flora and Fauna

The vegetation in the area has changed due to rice farming. The current vegetation is mainly planted rice and some isolated sugar cane. However, remnants of the original vegetation (reeds) could be seen at the proposed site. The project site has mainly wetland grass, that will have to be cleared.

The animal species in the area include birds (Quella), rats, snakes and frogs.

4.6 Socio-Economic Setting

The economic activities in the area are mainly agricultural activities (both commercial and subsistence), trade and formal employment. The local trading centre is known as Ayweyo Chogo Trading Centre mainly composed of small retail shops, butcheries, small hotels and posho mill. County Government of Kisumu is one of the counties that have employed people therefore improving their socio- economic power.

4.7 Support services

The site will not be complete until support facilities are put into place. These will include;

- ii) Offices,
- iii) Sanitation facilities (toilets, bathrooms, hydrants, wastewater drains,
- iv) Health and safety provisions (fire extinguishers, hydrants, signage, exits, first Aid points etc., Security arrangements

4.8 Site alternative

The development of feasible alternatives, to meet the overall objectives of the proposal calls for technical knowhow and informed knowledge. During this process of alternatives review to the proposed project, reference is made to:

a) Available technology,

The site is expected to be designed such as to ensure optimal utilization of space, ensure minimal waste movement, easy and safe movement for the forklifts and other machines. At full operations infrastructures is expected to help irrigate the area. **Policy objectives,**

The main objective of the proposed project is designed to meet the policy objective of The Environmental Management and Coordination Act in managing of all issues that pertains to clean and healthy environment since everyone is entitled to clean and healthy environment (Section 3 of EMCA). Policy for environmental management entails that there should be cleaner development mechanisms and this means that every development should have measures in place

to ensure that produced waste is managed at source and that natural environment is not disturbed in a negative way.

b) Social attitudes,

The proposed project should in line with the development of the surrounding areas. Consultation to the local communities should be a mandatory process to the project implementation to ensure inclusivity in the project cycle. The local residents must be receptive to the project to ensure smooth running and coexistence. This ensures that the community's interests are taken care of. The process will therefore include publishing the proposed project in the local dailies and radio station to create awareness.

c) Environmental and site constraints and project economics

Irrigation requires enough space to ensure that there is no interference from all quotas. This has necessitated acquiring of enough space for the management of all irrigation.

4.9 Alternative (existing location)

For enhanced productivity the scheme expansion is necessary and the expansion appropriate since the land is available and this can be done in the most sustainable way after considering the impacts of the current design

4.10 Alternative 2 (Proposed location)

Following the current scenario illustrated above on the current design in the process of infrastructures installation and operation. This conclusion has been arrived at due to the following considered reasons;

- ii) The land is legally acquired by the county government making the development more feasible as planned,
- iii) There are no significant settlements around the site, and hence it will be possible to present a case of appropriate zoning in future to the County Government Authorities to ensure minimal social impacts
- iv) There are no significant environmental sensitive features around the site (no forest cover, not sensitive habitats noted, etc.). It is, therefore, likely to have minimal environmental impacts,
- v) The County Government of Kisumu is ready to abide by the law for a long term suitability of the site.

4.11 Project cost and implementation

The projected will cost Ksh.234, 200, 000 including the legal costs,

CHAPTER FIVE: ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 Introduction

For the proposed development, potential positive and negative impacts were identified both for the construction phase and operation phases. Throughout this report, impacts have been characterized as;

- a) “Positive” when they;
 - Enhance socio-economic welfare e.g. food security, income, employment,
 - Enhance quality of existing environment.
- b) “Negative” when they;
 - Reduce socio-economic welfare of people,
 - Reduce quality of existing environment,
 - Reduce economic value e.g. of surrounding property.
- c) “First order” (or direct) impacts;
 - Are directly caused by a specific action as the primary effects.
 - Occur at the same time and location as the action.
- d) “Second order” (or indirect) impacts result from effects of the first order impacts.
- e) “Third order” impacts are result from incremental effects of second order impacts.
- f) “Reversible” impacts can be completely reversed while “Irreversible” impacts cannot be completely reversed.
- g) “Short-term” impacts last only a short duration probably a few days or months.
- h) “Medium-term” impacts could last a few years.
- i) “Long-term” impacts would persist for many years or decades.

5.2 Construction-Phase Impacts

5.2.1 Positive impacts

5.2.1.1 Income to material/ equipment suppliers and contractors

Proposed extension, alteration and refurbishment will necessitate procurement of equipment, construction materials and service, providing income to suppliers and contractors. This is a positive but short-term and reversible impact.

Enhancement measure

Earth materials needed for construction e.g. murrum, aggregate (stone, sand) are obtained from quarry operations. Conscious or unwitting purchase of these materials from unlicensed operations indirectly supports, encourages and promotes environmental degradation at illegal quarry sites and can cause medium- to long-term negative impacts. It should therefore be a contractual obligation for contractors to procure construction materials from legitimate or licensed sources (as advised by authorities).

5.2.1.2 Employment – socio – economic benefit

Several positive impacts are expected from the development of the projects. These include the generation of employment for skilled and unskilled labour in the short to medium term.

Negative impacts

5.2.2.1 Mud and particulate matters generation during construction

During the construction phase the earth work will generate mud during excavation. The mud can find its way to water course hence pollution. During dry season this might generate particulate matter and the may be reinforced by traffic movement

The main impacts of the mud conditions are;

- Low water quality by interfering with light penetration, pH among other parameters
- Affect ecology of benthic macrobenthic invertebrates
- Interferes with nutrients dynamics

The main impacts of the particulates conditions are;

- Aesthetic and visual problems, though there are no notable settlements within the vicinity of the site,

- Potential risks of health (mainly bronchial infections) though there are no notable inhabitants in the immediate neighborhoods,
- Deposition of dust on vegetation hampering development of the same,
- Air pollution aspects including contribution towards climate change.

Mitigation measures

Since this area is a wetland there will be no much dust generate and this activity will be carried out during dry spell therefore mud will not be an issue.

5.2.2.2 Noise levels

Construction hand tools and transport trucks will be a major source of noise to the surrounding areas. This will affect the workers and surrounding. It was noted that the immediate southern land has not been developed and hence effects of noise during construction will not have significant social implications.

Impact mitigation measures

- Initiate a noise mapping programme and keep monitoring,
- Undertake an annual hearing survey of all the workers,
- The contractor should ensure that noise levels emanating from machinery, vehicles and noisy construction activities are kept at a minimum for the safety, health and protection of people in buildings being renovated.
- Training, provision of ear muffs/corks and enforce application,

5.2.2.3 Injury to workers by construction activities

The construction activities will be carried out during the installation of the irrigation infrastructures. This will involve the use of construction materials equipment and machineries.

During this period things like accidents are likely to occur.

Impact mitigation measures

- Contractors should cordon off areas under construction.
- Ensure good housekeeping and clean operations always immediately removing rubble strewn outside construction areas.

- Construction workers should be aware of the sensitive nature of workplaces they are operating in and advised to limit verbal noise or other forms of noise. For example, metallic objects or tools can be passed on to a colleague below to be quietly laid down instead of dropping them on cement etc.
- Contractors should use screens or nets to avoid flying debris.
- Besides supervision by county engineers, contractors' contracts can have a clause authorizing a county works officer to advise contractors against careless handling of machineries.

5.2.2.4 Solid waste

During the construction period there will be generation of different types of solid wastes within and around the site. The earth moving work daily operation activities will generate solid wastes.

Impact mitigation measures

- Disposal of waste would be done in accordance to waste regulations.
- Contractor to undertake safe waste disposal,
- Verify legality of waste disposal destination

5.2.2.5 Social impacts

There are no displacements or direct interference with any social groups within and around the site since no settlements were found at the time of this assessment. Anticipated social impacts would be related to gaseous emissions, generation of mud, dust and noise but there are no inhabitants in the immediate neighborhood of the site. However for any eventuality the following mitigation will be adopted.

Impact mitigation measures

- Address concerns of neighbouring land users as per this report,
- Integrate public safety in the construction process,
- Utilize local labour for construction for enhancement of social harmony

5.2.2.6 Biodiversity loss

There will be little disturbance to biodiversity at the site location being covered by mono plant grass and rice fields. Establishment of new vegetation will be done in the area after installing the facility.

Impact mitigation measures

- Introduction of vegetations (trees, shrubs and grass) on open spaces within and around the site.
- Indigenous species would be preferred.

5.2.2.7 Water Quality

There is permanent source of surface water (River Awach) at the site vicinity. Therefore there are anticipated impacts on water quality. These include, oil spills from the machinery and depositions at the construction site camp has the potential for contamination of surface runoff (that may eventually end up into surface water streams) or infiltrate into the groundwater sources. The sediment from the excavation exercise can also pollute down stream water by increasing suspended solids.

Mitigation measures

- The contractor will ensure the standard regulations guidelines are followed and adhered to
- Oil spillage chances will be minimized since machineries will be serviced regularly

5.2.2.8 Health and Safety

The main concern in this regard is the occupational welfare of the construction workers from the emissions from the machineries and the risk of accidents. Health and safety concerns will eventually be addresses during the operation states of the station. The concerns are projected to come from the excavation and generation of mud and handling process. Neighbouring residents are not likely to be affected since the construction site will be fenced off to keep off intruders.

There will be increased likelihood of increased incidences of diseases like bilhazias and malaria among workers. For bilhazia the worker will be provided with appropriate work gears and for

malaria, use of treated mosquito nets will be promoted. There will be also likelihood of increased prevalence HIV/AIDS.

Mitigation measures

- The HIV/AIDS will be addressed through integrated approaches like awareness creation among the workers and communities and establishment HIV/AIDS management approaches.
- Malaria control campaign through use of treated mosquito net and prophylaxis
- Bilhazia problems will be addressed through awareness on use of protective gears and vaccination among workers.

5.2.2.9 Traffic accidents

Construction activities may result in a significant increase in number of heavy vehicles during transport of construction materials and equipment, increasing community risk of traffic related accidents or injuries to workers. Traffic accidents would be a significant social impact and especially likely to involve children, women (who commonly cross roads slower than men), disabled and elderly people. Impact duration will be short-term occurring only during the construction phase. Extent of this impact will be on all roads plied by project vehicles. The likelihood of the impact occurring is high when control measures are not instituted. The social cost and significance of this impact is high especially if it involved loss of human life which is also irreversible.

Impact mitigation measures

3. Adopt best transport safety practices with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public, as follows:
 - Emphasizing safety aspects among project drivers. Specifically ensure drivers respect speed limits through built areas and urban centers.
 - Adopting limits for trip duration and arranging driver rosters to avoid overtiredness
 - **Avoiding dangerous routes and times of day to reduce the risk of accidents** Position traffic guides at children crossings to control driver speeds.
 - Employ safe traffic control measures, including road signs and flag persons to warn of dangerous conditions and children crossings.

4. Ensure contractors regularly maintain vehicles to minimize potentially serious accidents such as those caused by brake failure commonly associated with loaded construction trucks.

5.2.3 Operation Phase Impacts

5.2.3.1 Positive impacts

b) Improved food security services at healthcare facilities

The project will have a long-term positive impact on food security and livelihood in Kisumu County and Kenya as a whole. The construction of new irrigation infrastructure will enhance improved rice production.

c) Employment opportunities

The construction of the infrastructure process will result into expanded scheme that will provide employment opportunities' to the locals like professional laborers and security guards, etc.

d) Improved incomes

Farmers in the scheme will realize improved production of rice which they will sell to boost their households' incomes.

e) Improved aesthetics and life of irrigation facilities

Construction will improve aesthetics of the scheme which, in present state, look unplanned. Construction will also give the scheme extended life.

5.2.3.2 Negative impacts

5.2.3.2.1 Air Quality

Holding areas for the irrigation water is likely to produce methane and other greenhouse gasses that will find their way into the atmosphere. This will result into global warming in the area, however this might not be significant since this is small scale irrigation system.

Impact mitigation measures

- Install gadgets to estimate the greenhouse gasses emissions around the premise.

- This is a small scheme that cannot produce significant amount of greenhouse gasses.

5.2.3.2.2 Water Quality

There is permanent source of surface water (River Awach) at the site vicinity. Therefore, there are anticipated impacts on water surface water quality. The irrigation activities will results into water disturbance and enhance nutrients.

Impact mitigation measures

Continuous water quality parameters assessment through regular measurement of water quality indicators and analysis of nutrients.

5.2.3.2.3 Environmental problem

The key environmental pollution anticipated from the site activities includes the following;

- Discharging irrigation wastewater into open river system around the construction site that would subsequently be carried into public water sources through surface runoff.
- Residuals suspended solids, oils and lubricant residuals as well a mixture of any contaminants brought along the materials. This has potential impacts on peoples health and the aquatic life,
- Discharge of oil residuals into open drains from point sources (moving machine parts, storage areas, delivery bays, etc) are potential sources of environmental contamination,
- Disposal of inert solid waste from the premises could become an extended environmental problem that would affect physical environmental quality, biodiversity and public health at points of disposal.
- Increased evaporation in irrigated areas can cause instability in the atmosphere, as well as increase levels of rainfall downwind of the irrigation. These changes to the climate are a direct result of changes to natural moisture levels in the surrounding atmosphere.
- Increased incidences of flooding in the area **Impact mitigation measures**
- Equipment specifications to conform with environmental standards,
- Integrate environmental components in the site design (waste management, emission controls, etc.),

- Apply to the extent possible provisions of the waste management regulations, County Government laws and by-laws, Public Health Standards, etc.,
- Enhance in-house awareness and sensitization on environmental protection initiatives,
- Flooding will be addressed by installing water control gate valves to monitor the amount of water permitted in and released.

5.2.3.2.4 Health and Safety

There will be increased likelihood of increased incidences of diseases like bilhazias and malaria among workers. For bilhazia the worker will be provided with appropriate work gears and for malaria, use of treated mosquito nets will be promoted.

Mitigation measures

- Malaria control campaign through use of treated mosquito net and prophylaxis
- Bilhazia problems will be addressed through awareness on use of protective gears and vaccination among workers.

5.2.3.2.5 Misuse or inability to use installed infrastructures

This project would be in vain if farmers and technical staff had no requisite training and skill to use constructed infrastructure for improved service delivery. This would be a significant, negative medium-term but reversible impact.

Impact mitigation measures

- Provide requisite training during infrastructure installations.
- There will be regular supervision, ensure only trained authorised personnel operate equipment.

5.2.3.2.6 Not maintaining improved facilities

When improved facilities are not continually maintained, they would quickly degenerate to preproject condition. This would be a negative, significant medium-term impact of local spatial extent but reversible.

Impact mitigation measures

- The design will ensure frequent assessment and maintenance of the facility to safe guard the deteriorating condition.

CHAPTER SIX: ENVIRONMENTAL IMPACT MONITORING & MANAGEMENT PLAN

This environmental management plan, EMP table for proposed construction of irrigation facility, identifies potential environmental aspects that should be monitored. It identifies parties responsible for monitoring actions, associated costs, indicators and training or capacity building needs and reporting. Various aspects of the EMP are detailed in sections below

6.1 Institutional arrangements

6.1.1 Institutional structure and responsibilities

Institutional responsibility of implementing this EMP will rest with the Project Coordination Unit, PCU (or Task Team) at Department of Agriculture, Livestock and Fisheries to be led by the Department Chief Officer. A key role of the unit would be among others, to review consultants' reports for compliance with the ESMP. Other roles will be:

- Monitoring implementation of mitigation actions by contractors
- Coordinating training and capacity building where planned
- Periodically reports about implementation of the EMP

The department affirmed that all its personnel to be involved in implementation of this EMP are adequately qualified and were appointed based on their qualification and suitability for respective roles. There is thus no training provided for them under this EMP.

Oversight to ensure mitigation actions are implemented will rest with the Department of Agriculture workers at the site, Project Coordination Unit, In-charge Officials of the facility and Clerk of Works will have similar responsibility.

Department of ALF shall require contractors to comply with this EMP and where a contractor has an Environmental Officer s(he) will undertake environmental supervision during construction. However, where a contractor does not have an Environmental Officer the supervising engineer or site manager/ contract manager should be given environmental orientation relevant to this EMP so as to execute required environmental supervision roles. This might not be necessary if the

supervising engineer has working environmental knowledge (most civil engineers do). Additionally a “Clerk of Works” should be employed to represent client’s environmental objectives and interests during construction phase. As a hiring criterion, such a person should have a background in environmental issues, particularly associated with construction projects.

The County Environment Officer will be responsible for overseeing environmental protection on behalf of NEMA. However in case the officer doesn’t exist, the NEMA county director will be fully responsible. These will have implementation and monitoring roles during execution of this EMP. Usually, these officials lack adequate facilitation so the project will need to provide auxiliary financial assistance for them to have effective participation in this project. Based on their professional knowledge or recommendations in this EIA, local environmental officers may have role in project design as advisors to engineering consultants on some aspects.

6.1.2 Monitoring and reporting arrangements

Monitoring will verify if predicted impacts have actually occurred and check that mitigation actions recommended in the EIA are implemented and their effectiveness. Monitoring will also identify any unforeseen impacts that might arise from project implementation.

- Who monitors and how: Monitoring will be undertaken by Department ALF and Environmental Officers who represent NEMA at local administrative. Monitoring by NEMA as their regulatory mandate.
- Government agency that may undertake “third party monitoring” is the Occupational Health & Safety Department. This unit has authority to inspect any facility for compliance with national requirements on safety in workplaces.
- Monitoring will be done through site inspection, review of grievances logged by stakeholders and ad hoc discussions with potentially affected persons

Frequency: Monitoring will be undertaken monthly over the construction period.

Audits: Audits will be necessary both during construction and project operation. While construction audits will aim to verify compliance to impact mitigation requirements,

postconstruction audits are a regulatory requirement within 12 months and not more than 36 months after completion of construction.

Both construction and post-construction audits can be conducted internally by Department of ALF staff or by a consultant hired by the county government. If undertaken by a hired consultant, a budget has been proposed for both in this EMP.

Reporting: Concise monthly monitoring reports should be compiled by Department of ALF's Project Coordination Unit (PCU) and shared with other interested stakeholder.

Construction- and post-construction phase auditing should culminate in reports that Department ALF shall share with NEMA or other interested stakeholders. Note that while the department is under no obligation to disclose construction phase audits, annual post-construction audits must be submitted to NEMA as a regulatory requirement.

6.1.3 Grievance mechanism

This section describes avenues for affected persons to lodge a complaint or express a grievance against the project, its staff or contractors during project implementation. It also describes the procedures, roles and responsibilities for addressing grievances and resolving disputes. Every aggrieved person shall be able to trigger this mechanism to quickly resolve their complaints.

The objectives of the grievance process are:

- i) Provide affected people with avenues for making a complaint or resolving any dispute that may arise during the project's activities.
- ii) Ensure that appropriate and mutually acceptable corrective actions are identified and implemented to address complaints;
- iii) Verify that complaints are satisfied with outcomes of corrective actions; iv) Avoid the need to resort to judicial proceedings.

The grievance mechanism will be fed from three main sources:

- Community residents, patients or health workers.
- Supervising engineer, clerk of works or contractor.
- Monitoring team who will forward issues/concerns identified in the field.

Steps of the grievance process are described below.

Step 1: Receipt of complaint

A verbal or in written complaint from a complainant will be received by the Clerk of Works and recorded in a complaints log s(he) keeps on site. The log will indicate grievances, date

lodged, action taken to address complaint or reasons the grievance was not acted on; information provided to complainant and date the grievance was closed.

Grievances should be lodged at any time, either directly to the Clerk of Works' office. The process for lodging a complaint is outlined below:

- i) Clerk of Works receives complaint(s) from complainant and records it in log (in English).
- ii) Clerk of Works reads the recorded complaint translating it into local language for the complainant to confirm correct detail of complaint has been documented.
- iii) Complainant signs the log to confirm grievance was accurately recorded.

Step 2: Determination of corrective action

If in his view, a grievance can be solved at this stage, the Clerk of Works will determine a corrective action in consultation with the aggrieved person. A description of remedial action(s) and time within which they must be accomplished and the party responsible for implementing them will be recorded in the complaint log.

Grievances will be resolved and status reported back to complainants within 5 days. If more time is required this will be communicated clearly and in advance to the aggrieved person. For cases that are not resolved within the stipulated time, detailed investigations will be undertaken and results discussed not more than 1 month from lodging a grievance.

Step 3: Meeting with the complainant

The proposed corrective action and the timeframe in which it is to be implemented will be discussed with the complainant within 5 days of receipt of the grievance. Consent to proceed with the corrective action will be sought from the complainant

Step 4: Implementation of corrective action

Agreed corrective action will be undertaken by the project or its contractor within the agreed timeframe. The date of the completed action will be recorded in the log against the complainant's grievance.

Step 5: Verification of corrective action

To verify satisfaction, the aggrieved person will be asked to return if not satisfied with the corrective action.

Step 6: Action by DALF and project contractors

If the Clerk of Works cannot solve the grievance, he will refer it to DALF (and contractor) through the Supervising Engineer. It is believed all possible grievances can be solved at this level.

6.1.4 Environmental Monitoring & Management Plan

Impact and Mitigation/Enhancement commitments	Desired Outcomes	Monitoring: Performance Indicators/Targets or Acceptance Criteria	Timing	Responsibility	Incremental Costs (Ksh.)	Capacity Building and Training Requirements
CONSTRUCTION PHASE						
Positive impact						
Income to equipment and material suppliers						
Project will promote local procurement where technically or commercially reasonable and feasible.	Ensure that local communities and businesses benefit from procurement process	Number of local businesses benefiting from construction related procurement	Before and during commencement of extension, alteration & refurbishment	Department of Agriculture, Livestock and Fisheries (DALF) and Contractor	Negligible	None
For earth materials, procure from legitimate sources to avoid encouraging environmental degradation	Project's material demand does not encourage environmental degradation	All quarries from which materials (sand, stone) are obtained are licensed by the authorities.	Before and during construction	DALF and Contractor	Negligible	None
Negative impacts						
Mud and particulate matters generation during construction						

The earth work will generate mud during excavation. Since this area is a wetland there will be no much dust generate and this activity will be carried out during dry spell therefore mud will not be an issue	Reduce water pollution and potential risks of health (mainly bronchial infections)	Public complaints Changed water color	During the construction period	DALF and Contractor	Negligible	Application of various types of PPE and their proper use.
During dry spell the materials will be kept dump	Workers have adequately clean air	The amount of dust in the vicinity and public complaints	During the construction	DALF	Negligible (should be part of contractor's bid)	None
Noise level						
Ensure good site keeping and clean operations always removing immediately removing rubble strewn outside construction areas.	No construction material is dangerously strewn Around work area	No rubble strewn kept in construction area	During construction	DALF and Contractor	Negligible	Good construction practices

Construction workers should limit verbal noise or other forms of noise during the	No excessive construction noise	Public do not complain about noise during the construction	During construction	DALF and Contractor	Negligible	None
construction work						
Contractors should fence the site	No debris noted outside construction areas	No complaints about flying debris from construction areas (this should be verified by perusal of records in complaints log)	During extension, alteration & refurbishment	DALF and Contractor	150,000	None
Injuries to workers						
Contractors should cordon off areas under construction and provide signage to warn of ongoing construction works.	Construction works do not cause injury to patients and health workers	Zero injuries in any month of construction phase	During construction work	DALF and Contractor	Negligible	None
Traffic accidents						

Ensure drivers respect speed limits through built areas and urban centers.	No road accident by project traffic	No accident occurs in each month of construction duration	During construction work	DALF and Contractor	Negligible	Contractor needs speed awareness through built areas and urban areas
Employ safe traffic control measures, including temporary road signs and flag persons to warn of dangerous conditions and children crossings	No road accident by project traffic	No accident occurs in each month of construction duration	During construction work	DALF and Contractor	120,000	None
Improper management of waste (and general construction)						
Seek guidance of local environmental officers to identify acceptable disposal sites	No dumping construction waste in non-designated areas	Contractor has records of proper waste disposal indicating quantities dumped and location of dumping site,	Throughout the construction period	DALF ; Contractor; County Environmental Officer.	Negligible	None

Contractors should undertake waste segregation at source to separate hazardous from non-hazardous waste	Hazardous waste (if any) separated from nonhazardous waste on site and each waste stream disposed of according to NEMA requirements in designated sites.	Separate containers on site	Throughout the construction period	DALF ; Contractor; County Environmental Officer.	Negligible	Likely hazardous and non-hazardous construction waste
Waste (such as metal scrap or wood waste) that can be reused/ recycled may be given to local people.	Amount of waste disposed of minimized by reuse, wherever feasible	Record of material types and estimated quantity diverted for reuse	Throughout the construction period	Contractor;	Negligible	-
Seek guidance of local environmental officers to identify acceptable disposal sites.	Waste disposed of at designated sites	No complaint of waste dumped illegally in non designated sites	Throughout the construction period	County Environmental Officer.	Negligible	-
Biodiversity loss						

<p>The removal of vegetation during the construction will cause loss of biodiversity.</p> <p>Introduction of vegetations (trees, shrubs and grass) on open spaces within and around the site.</p> <p>Indigenous species would be preferred.</p>	<p>The destruction of vegetation will be minimized</p>	<p>A written preconstruction plan available on site to rearrange service areas so as to minimize disruption of vegetation. No species monopolise the site</p>	<p>Throughout the construction work</p>	<p>DALF ; Contractor; and area environmental officer</p>	<p>Negligible</p>	<p>None</p>
<p>Social misdemeanor, health and safety by construction workers</p>						

<p>As a contractual obligation, contractors should be required to have an HIV/AIDS policy and a framework (responsible staff, action plan, etc) to implement it during project execution.</p> <p>Awareness training on HIV/AIDS should be provided to construction workers</p>	<p>No illicit sexual relationships among construction workers and local community</p>	<p>All construction workers are aware of HIV/AIDS risk and responsible living.</p> <p>All construction workers living in a camp adhere to a “No fraternization” and comply with latest entry time into camp (6PM) set to avoid prostitution.</p>	<p>Throughout construction period</p>	<p>DALF</p>	<p>100,000</p>	<p>None</p>
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<p>There will be increased likelihood of increased incidences of diseases like bilhazias and malaria among workers. For bilhazia the worker will be provided with appropriate work gears and for malaria, use of</p>	<p>No or minimum cases of malaria and bilhazia</p>	<p>Number of malaria and bilhazia reported in the health facilities</p>	<p>Throughout the construction period</p>	<p>DALF, Contractor and department of health</p>		
<p>treated mosquito nets will be promoted.</p>						
<p>Impact of material transport</p>						

<p>Fine earth materials (sand, murrum) should be covered during haulage to facilities under alteration to prevent spillage and dusting</p> <p>Road dust should be controlled through bowing or speed control)</p>	<p>No material spills on roads during haulage to sites</p>	<p>No accidents caused by construction material split on road</p>	<p>Throughout the construction period</p>	<p>DALF ; Contractor; Police</p>	<p>Negligible (this should be part of contractor's bid)</p>	<p>None</p>
<p>Impact of construction activities</p>	<p>Construction activities do not cause adverse socioenvironmental impacts</p>	<p>Annual construction audits do not indicate adverse impacts not mitigated</p>	<p>time per year</p>	<p>DALF (construction audit may be undertaken by DALF or consultant it hires)</p>	<p>180,000</p>	<p>Environmental auditing of construction projects</p>

Water quality problem

<p>There is permanent source of surface water (River Awach) at the site vicinity. Therefore there are anticipated impacts on water quality.</p> <p>The contractor will ensure the standard regulations guidelines are followed and adhered to Oil spillage chances will be minimized since machineries will be serviced regularly</p>	<p>No change of water color</p>	<p>Public complaints</p>	<p>Throughout the construction period</p>	<p>DALF, contractor and department of water</p>	<p>Negligible</p>	<p>Non</p>
OPERATION PHASE						
Positive impacts						
Improved livelihood						

The project will have a long-term positive impact on food security and livelihood in Kisumu County and Kenya as a whole. The construction	Construction of irrigation infrastructure in Gem Rae scheme	The DALF have trained staff to properly and safely operate the	12 month after facility construction	DALF and contractor	None (procurement cost assumed to include training)	Staff training in operation of newly installed irrigation equipment
of new irrigation infrastructure will enhance improved rice production.		infrastructure				
The construction of the infrastructure process will results into expanded employment opportunities' to the locals like professional laborers and security guards, etc.	Construction of irrigation infrastructure in Gem Rae scheme	Contractor and DALF employ staff towards the project	Immediately	DALF and farm owners	Kshs.300,000 per year	Training in specified areas

Farmers in the scheme will realize improved production of rice which they will sell to boost their households' incomes.	Farming activity going on well	Increased rice production	After 12 months	Farmers and farmer groups		Group training on marketing
Construction will improve aesthetics of the scheme which, in present state, look unplanned. Construction will also	The design and farming of rice will make the place beautiful with installed	Feedback from the public	Immediately	Contractor, farmers and DALF	No direct cost	None
give the scheme extended life.	infrastructure					
Negative impacts						
Air quality						

<p>Holding areas for the irrigation water is likely to produce methane and other greenhouse gasses that will find their way into the atmosphere.</p> <p>Install gadgets to estimate the greenhouse gasses emissions around the premise.</p>	<p>No excess offsite air pollution from water holding areas</p>	<p>Visual observation reveal no plume and temperature remains unchanged</p>	<p>From start of use of water holding area</p>	<p>DALF</p>	<p>Negligible</p>	<p>None</p>
<p>Consultations with potentially affected people should be done by design consultant to assess the effect among the communities</p>	<p>The community should be informed about the expected impacts</p>	<p>Record of consultation with communities near the proposed project site</p>	<p>At public participation stage</p>	<p>DALF and contractor</p>	<p>Kshs 200,000</p>	<p>None</p>
<p>Health and safety</p>						

<p>Increased incidences of diseases like bilhazias and malaria among workers. For bilhazia the worker will be provided with appropriate work gears and for malaria, use of treated mosquito nets will be promoted.</p>	<p>No community health risk due to irrigation project</p>	<p>Number of cases reported</p>	<p>continuous</p>	<p>DALF and Department of health</p>	<p>Kshs. 100,000</p>	
<p>Misuse or inability to use installed infrastructures</p>						
<p>The project would be in vain if farers and technical staff had no requisite training and skill to use constructed infrastructure for improved service delivery. This would be a significant, negative medium-term but reversible impact.</p>	<p>Engagement of trained staff that can handle the activities work</p>	<p>All staff have adequate training</p>	<p>Continuous</p>	<p>DALF and Contractor</p>	<p>Negligible (all requisite to be provided as part of by equipment supplier bid).</p>	<p>None</p>

<p>Provide requisite training during infrastructure installations. There will be regular supervision, ensure only trained authorised personnel operate equipment.</p>						
<p>Not maintaining improved facilities</p>						
<p>When improved facilities are degenerate to pre-project condition. This Every farmer would be a negative, group has 180,000 significant medium-term impact of local spatial basic capacity extent but reversible. to repair and maintain the The design will ensure irrigation infrastructure maintenance of the deteriorating condition.</p>	<p>not continually maintained, they would quickly</p> <p>per The technicians</p> <p>Each farmer group has minimum of 1 operation trained facility to safe guard</p>	<p>maintained, they would quickly</p> <p>a equipment technician frequent the</p>	<p>they would quickly</p> <p>Chief installation assessment</p>	<p>quickly</p> <p>Officer upon DALF and</p>	<p>should be continuously</p>	
<p>Misuse or inability to use constructed equipment</p>						

Provide requisite training during infrastructure installation	Irrigation infrastructure not misused and operated by qualified staff	The scheme to have qualified staffs to operate the installed infrastructure	1 month upon completion	DALF	Negligible (assumed part of procurement budget)	None
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CHAPTER SEVEN: CONCLUSION

The proposed project has potential to significantly improve food security and household income in Kisumu County with socio-environmental benefits such as employment, improved livelihood and increased productivity of labor hence higher household incomes. Besides, project development and operation will provide considerable economic opportunity for material/ equipment suppliers and construction contractors.

A key significant negative impact will arise from excavation of land, waste management, especially solid waste. There is also likelihood of increased incidences of malaria and bilhazia. This impact will be addressed through public awareness on use of treated mosquito net and use of protective gargets to evade bilhazia infections. Water quality deterioration is also an eminent impact on water in River Awach. This will be addressed by frequent water quality monitoring to ascertain the quality parameters.

All potential adverse impacts are litigable when measures proposed (Chapter 5) are implemented, in which case benefits of this project to the nation would by far outweigh potential negative effects.

The proponent of the proposed project shall be committed to putting in place several measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project. It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the EMP as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects. It is expected that the positive impacts that emanate from such activities shall be maximized as much as possible as exhaustively outlined within the report. These measures will go a long way in ensuring the best possible environmental compliance and performance standards.

It is our recommendation that the project be allowed to go on provided the mitigation measures outlined in the report are adhered to, Environmental Management Plan (EMP) is implemented and the developer adhere to the conditions of approval of the project.

It is our recommendation that the project be allowed to go on provided the mitigation measures outlined in the report are adhered to, Environmental Management Plan (EMP) is implemented and the developer adhere to the conditions of approval of the project.

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APPENDICES**Copy of:**

- ✦ Bill of Quantities (BQ)
- ✦ Approved Construction Plans
- ✦ EIA Public Participation Comment Sheet

**APPENDIX 1. NYAKACH, NORTH NYAKACH WARD GEM RAE IRRIGATION
STRUCTURES: BILLS OF QUANTITIES**

ITEM	DESCRIPTION	Unit	Qty	Rate (Kshs.)	Amount (Kshs.)
1.0	BILL NO 1: PRELIMINARIES & GENERALS				
1.1	Hired Survey works to determine levels during construction, & Supervision works for the Resident Engineer	Lump Sum	1	890,000.00	890,000.00
1.2	Erect a standard bill board using metallic support and maintain it throughout the construction period and beyond	Lump Sum	2	60,000.00	60,000.00
1:3	Allow for provisional sum for material testing for concrete strength at public works yard at critical stages of civil works.	No.	12	25,000.00	300,000.00
1.4	Allow for Site office construction on a Hired Land using Timber and Galvanized iron sheets and any other locally available material	No.	1	550,000.00	550,000.00
	Total preliminaries				1,800,000.00
2.0	EARTH WORKS				
2.1.	Excavate and remove all vegetative & silt to connect the Main Canal of the scheme	m ³	450	500	225,000.00
2.2	Excavate and remove all vegetative & silt load along the Tertiary Canals of the scheme	m ³	1450	500	725,000.00
	Total Earth works				950,000.00
3.0	WEIR CONSTRUCTION WORKS				

	<i>WEIR: Construct Straight weir across Awach-Kano river to serve Gem-Rae scheme of average thickness 0.3m top width weir fitted with an open gate to receive stop logs & one off take gate.</i>				

3.1	RIVER DIVERSION				
3.1.1	Provide river diversion works on AwachKano river at two different sections and maintain during the construction period & reinstate back to normal or insitu diversion as advised	Lump Sum	2	600,000.00	1,200,000.00
	EXCAVATION WORKS				
	To include for all trimming to levels, backfilling with approved selected spoil, compacting, disposal of surplus material and reinstatement within weir & wing walls				
3.1.2	In normal soil to take weir and wing walls	m ³	650	500	325,000.00
	FOUNDATION WORKS				
3.2.1	Excavate and remove all vegetative & earth works along the main construction area to include for all trimming to levels, backfilling with approved selected spoil, compacting, disposal of surplus material and reinstatement within weir & wing walls structures.	m ³	3100	500	1,550,000.00
3.2.2	Hardcore: place selected clean rough stones not more than 300mm size on the finished foundation to a depth of 300mm	m ³	550	2,500.00	1,375,000.00

3.2.3	Murram : place compacted murram blinding and level to receive concrete	m ³	220	2,000.00	240,000.00
3.4	CONCRETE WORKS				
3,4.0	<i>Provide and place the following concrete using 42.5 mps (high strength) cement in all concrete & mixed with water proof additives for stability and including all formwork</i>				
3.4.1	Concrete grade 15/20 to receive slab for blinding under for footing	m ³	28	15,000.00	420,000.00
3.4.2	Reinforced concrete 20/20 in Y12 mess 200 c/c for weir slab complete with upper & lower apron in Y10 mess of 150mm c/c & 42.5 mps cement concentration	m ³	60	30,000.00	1,800,000.00
3.4.3	Reinforced concrete 20/20 in Y16 vertical bars for weir retention wall of the river 2m each side x 250mm crest thickness & cross bars apart in 42.5 mps cement concentration as specified in the drawing.	m ³	12	30,000.00	360,000.00
3.4.4	Reinforced concrete class 20/20 in Y12 for weir wing walls to run 150m each side of the river as directed.	m ³	140	30,000.00	4,200,000.00
3.5	METAL WORKS				
	<i>Provide and install the following gate from Prequalified suppliers for irrigation gates</i>				
3.5.1	Intake gate: Fabricate and install a spindle (Ø 50mm) gate with a 50mm angle bar frame size 2 m x 1.4m with a metallic plate size 1 m x 1 m x 10mm thick as shown in the drawing	No.	2	180,000.00	360,000.00

3.5.2	Gate: A spindle (Ø 38mm) gate with a 50 mm angle bar frame size 1200 mm x 1000 mm with a metallic plate 600 mm x 800 mm x 6 mm thick as indicated in the drawing	No.	3	100,000.00	300,000.00
3.6	EMBANKMENT PROTECTION				
3.6.1	GABION WORKS				
	<i>Provide and place triple twisted hexagonal shaped galvanized mesh wire size 100 mm by 80 mm. Inclusive of Geotextile filter cloth and filling with boulders and binding.</i>				
3.6.1	Gabion boxes of dimensions 2.0 m x 1.0 m x 1.0m mounted on the wing walls, at both sides of the riverbank as directed.	No	160	6,000.00	960,000.00
3.6.2	Geotextile filter cloth with minimum weight of 270g/m ² and minimum thickness of 2.3 mm. between the structure and embankment	m ²	360	1,500.00	540,000.00
3.6.3	Filling with boulders/stones and binding	m ³	180	2,000.00	360,000.00
3.7	PLASTERING				
3.7.1	Provide and apply 18 mm thick plaster of 1:3 mixtures with waterproof cement at a ratio of 2kg per 50kg cement bag.	m ²	300	1,000.00	300,000.00
3.8.1	Allow for 5% contingency on costs due to Price fluctuation, Inflation, delays due to bad weather and any unforeseen required works	Lump Sum	1	410,000.00	410,000.00
	Summary of Plaster works & Others				710,000.00
TOTAL FOR WEIR					12,475,000.00

4.0	LINED CANAL ON MAIN FEEDER				
4.1	EARTHWORKS				
	<i>To include for all trimming to levels, backfilling with approved selected spoil, compacting, disposal of surplus material and reinstatement</i>				
4.1.1	Excavate and remove all vegetative & earth works along the main construction area of the structures.	m ³	1700	500	850,000.00
4.1.3	Murram : place compacted murram blinding and level to receive concrete	m ³	225	2,000.00	450,000.00
4.2	CONCRETE WORKS				
	<i>Provide and place the following concrete using 32.5 mps. (normal strength) cement in all concrete & mixed with water proof additives for stability and including all formwork</i>				
4.2.1	Concrete blinding grade 15/20 to receive reinforced slab and wing wall reinforced concrete footing beam throughout the total linier length of 1700mm	m3	110	15,000.00	1,650,000.00
4.2.2	Reinforced concrete 20/20 in BRC No. A145 mess for slab base complete with Y12 bottom beam to receive side walls as specified in 32.5 mps normal cement concentration	m3	230	20,000.00	4,600,000.00

4.2.4	Reinforced concrete 20/20 in Y12 for canal side wing walls complete with Y10 parallel side bars, 1710m length in each side and casted monolithique with the base beam as directed & sub-divided at 5m interval across the structure using approved 25mm none heat conductor foil.	m3	270	25,000.00	6,750,000.00
4.4	METAL WORKS				
	<i>Provide and install the following gates from Atinga engineering works Kisumu (Prequalified for supply of irrigation gates)</i>				
4.4.1	Intake gate: Fabricate and install a spindle (Ø 30mm) gate with a 50mm angle bar frame size 700mm x 600mm with a metallic plate size 700mm x 600mm x 10mm thick as shown in the drawing	No.	4	110,000.00	440,000.00
	Summary of Lined Canal				14,300,000.00
5.0	BILL NO 5 : BOX CULVERT				
5.1	EXCAVATION WORKS				
	<i>To include for all trimming to levels, backfilling with approved selected spoil, compacting, disposal of surplus material and reinstatement Size 1.0x0.8x5.0m</i>				
5.1.1	In normal soil n.e. 1.0 m, as instructed by Engineer, to take foundation	m ³	50	500.00	25,000.00
					-
5.2	Murram : place murram on the finished surface , compact and level to receive blinding	m ³	15	2,000.00	30,000.00
					-
5.3	CONCRETE WORKS				-

					-
	<i>Provide and place the following concrete mixes including all formwork</i>				-
					-
5.3.1	Concrete grade 15/20 blinding to receive slab	m ³	2	15,000	30,000.00
					-
5.3.2	Reinforced concrete 20/20 of culvert base slab in Y10 to receive wing walls for box culvert as shown in the drawing	m ³	7	20,000	140,000.00
					-
5.3.3	Reinforced concrete 20/20 of culvert wing walls and side brackets in Y10 to receive culvert deck as shown in the drawing	m ³	9	20,000	180,000.00
					-
5.3.4	Reinforced concrete 20/20 in Y12 for top deck slab of culvert including head wall as shown in the drawing	m ³	5	25,000	125,000.00
5.5	STONE PITCHING				-
					-
	<i>Provide and place the following riprap.</i>				-
5.5.1	Selected clean stones 200 mm in thickness grouted with 1:3 mortar at sections requiring protection	m ²	25	5,500.00	137,500.00
	Murraming				
5.6	Supply, spread in layers and compact graded murram over the completed box culverts at the sides and spread it over the culvert.	Tons	36	1,800.00	64,800.00
					732,300.00
					3,855,000.00
	TOTAL FOR BOX CULVERT- No. 4				
	TOTAL				40,400,000.00

