ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROJECT REPORT

PROPOSED INAYA COMMUNITY WATER PAN ON PLOT NO.MARAMA/LUNZA/136

LOCATION:

Plot No. Marama/Lunza/136 at Inaya Village, Ituti Sub-location, Shitari location, LunzaDivision in Butere Sub-county, Kakamega County

Latitude 0.228588º N and Longitude 34.588162º E

PROPONENT/FUNDING AGENCY:

The County Co-ordinator,
Kenya Climate Smart Agriculture Project (KCSAP)
Kakamega County
P. O. Box 27 – 50100
Kakamega, Kenya

Prepared for submission to the National Environment Management Authority (NEMA) by:

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March, 2019

CERTIFICATION

This is to certify that an EIA has been carried out for the Proposed Inaya Water Pan on Plot No. Marama/Lunza/136 at Inaya Village Shitari Location, Butere Sub-county in Kakamega County.The study was carried out by NEMA registered EIA/EA experts in accordance with Environmental Management and Co-ordination Act (EMCA), 1999 (Cap. 387), amended 2015 and the Environmental (Impact Assessment and Audit) Regulations, 2003. The experts also compiled this report. We the undersigned hereby certify that the information and particulars given in this report are correct as at the time the EIA was conducted.

FOR THE CONSULTANTS

Dr. Stanley O. Omuterema _____ _____
Lead Expert Reg. No: 0125 Signature Date and stamp
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FOR THE PROPONENT, KENYA CLIMATE SMART AGRICULTURE PROJECT (KCSAP)

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percentage
BQs	Bills of Quantities
Cap.	Refers to 'chapter' in the Laws of Kenya
CBO(s)	Community Based Organization(s)
CGK	County Government of Kakamega
CO	Carbon-monoxide
CO_2	Carbon-dioxide
dBA	Decibels (a unit of measuring sound)
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management and Monitoring Plan
ft	Foot/feet (a unit of measuring length)
GOK	Government of Kenya
Ha	Hectares (a unit of measuring land area)
hr(s)	Hour(s) (A unit of measuring time)
KCB	Kenya Commercial Bank
KCSAP	Kenya Climate Smart Agriculture Project
KEBS	Kenya Bureau of Standard
KeNHA	Kenya National Highways Authority
KERRA	KenyaRural Roads Authority
Km	Kilometer(s) (a unit of measuring distance)
KShs.	Kenya shilling(s) (a unit of measuring currency in Kenya)
KURA	Kenya Urban Roads Authority
m	Metre(s) (a unit of measuring length)
m^3	Cubic metre(s) (a unit of measuring volume)
mm	Millimeter(s) (a unit of measuring length)
NCA	National Construction Authority
NCLR	National Council for Law Reporting
NEMA	National Environment Management Authority
NGOs	Non-governmental Organization(s)
^{o}	Degrees (A unit of measuring latitudes and longitudes)
^oC	Degrees Celsius
OSHA	Occupational Health and Safety Act
P. O.	Post Office
PPE	Personal Protective Equipment
PVC	Polyvinyl chloride
Reg. No.	Registration number
spp	Species
TOR	Terms of Reference
WIBA	Work Injury Compensation Benefit Act

DEFINITIONS OF OPERATIONAL TERMS

Authority: Refers to NEMA established under section 7 of EMCA, 1999 (Cap. 387), amended 2015.

Decommissioning: This is the permanent withdrawal from a site or close down of a facility for restoration.

EA: The systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing in conservation or preservation of the environment.

EIA: A systematic evaluation of activities and processes of an upcoming project/ facility to determine how far these activities and programs conform to the approved environmental management plan of that specific project and sound environmental management practices.

EMP: Means all details of project activities, impacts, mitigation measure, time, schedule, costs, impact or activities, including monitoring and environmental audit during implementation and decommissioning phase of a project.

Environment: Physical factors of surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and social factor of aesthetics, culture and includes both the natural and the built environment.

Mitigation: Measures which include engineering works, technology improvement management ways and means of minimizing negative aspects, including socio-economic and cultural losses suffered by communities and individuals, whilst enhancing positive aspects of the project.

Project: Means any undertaking that may have an impact on the environment.

Proponent/ Developer: Means a person proposing or executing a project which is subjected to an EIA or undertaking an activity specified in the second schedule of EMCA, 1999 (Cap. 387), amended 2015.

Scoping: Is the process of determining the content and extent of the matters which should be covered in the environmental information to be submitted to a competent authority for projects which are subject to EIA.

Screening: It is a coarse analysis of the possible impacts of an action with a view to identifying those impacts which are worthy of detailed study for a project to be considered for an EIA process or not.

Standards: Means the limit of discharge or emission established under the Act or under Regulations.

Water Reservoir: Includes drinking water, river, stream, watercourse, reservoir, well, dam, canal, channel, lake, swamp, open drain or underground water

EXECUTIVE SUMMARY

Introduction

This document is an Environmental Impact Assessment (EIA) project report for the Proposed Inaya Water Panon Plot No. Marama/Lunza/136 at Inaya Village, Ituti Sub-location, Shitari Location, in Butere Sub-county, Kakamega County. The project Proponent consultedenvironmental experts licensed by the Authority to conduct an Environmental Impact Assessment (EIA) study for the proposed project and prepare a report for submission to the Authority, the National Environment Management Authority (NEMA).This report is prepared in accordance with Section 58 to Section 67 and Section 138 of the Environmental Management and Coordination Act (EMCA), 1999 (Cap. 387), amended 2015. The subsidiary legislation to the Act, the Environmental (Impact Assessment and Audit) Regulations, 2003 provides the framework for carrying out Environmental Impact Assessments (EIAs) and Environmental Audits (EAs) in Kenya by experts registered and licensed by the Authority. Environmental Impact Assessments (EIAs) should be followed by annual Environmental Audits (EAs) beginning 12 months from the date of commissioning of operations in order to determine the projects' compliance with regulations and set standards. The purpose of Environmental Impact Assessments (EIAs) is to identify potential positive and negative environmental impacts associated with the proposed project and thus provide recommendations on how to take advantage of the positive impacts on one hand and how to mitigate the negative environmental impacts on the other.

Methodology

The EIA team carried out the assessment using a combination of methods including ground surveys;review of the project-related documents; and interviews with the neighbours, project management and other interested people and parties including the area residents in the neighbourhood of the proposed project site.

Baseline information

The proposed site is neighboured by residential homes, Riverside Primary School and a stream. Emphasis was placed on describing proposed project area and its neighbourhood in terms of resources, vegetation, land-use patterns, socio-economic activities, population, topography, climate and geology among others so as to provide a basis from which the potential impacts can be predicted. The proposed site is found at Inaya Village, Marama West Ward in Butere Sub-county in Kakamega County. The main challenges facing development of the area are:

a) The increasing population which poses pressure on land resource;
b) Lack of properly defined public solid waste collection and disposal systems; and
c) Poorly maintained storm drainage lines which are associated with silt-filled culverts.

Project description

The proposed development is a water pan. The proposed dam works is funded by **Kenya Climate Smart Agriculture project**. The proponent intends to excavate an embankment reservoir with the objective of enhancing sustainable access and storage of water for small scale irrigation, fishing, and other domestic purposes within the beneficiary community.The proposed design will be approved by the Public Health, the Physical Planning and the County Engineer's offices.The construction of the proposed project will employ best and modern building technologies and materials that conform to the Kenya Bureau of Standards (KEBS) and internationally accepted standards. These building materials will be obtained locally through best procurement agreements between the Proponent and the contractor(s).

Review of relevant legislative frameworks, relevant literature and project designs and documents

Existing literature on statutory and other requirements was also reviewed. During the assessment, various Acts and Regulations were reviewed to gather information which would help in preparing the project. This review was done in both Kenya policy papers, Acts of Parliament, codes and regulations and international frameworks. Some of the legislations that were reviewed include:

1) The Constitution of Kenya, 2010
2) Environmental Management and Coordination Act, 1999 (Cap. 387), amended 2015
3) Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009.
4) The Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006
5) Fisheries (General) Regulations, 2012
6) The Irrigation Act, Cap 347 (Revised Edition 2012)
7) Environmental Management and Coordination (Noise and Excessive Vibration, and Pollution Control) Regulations, 2008
8) Environmental Management and Coordination (Waste Management) Regulations, 2006
9) Public Health Act, 1986 (Cap. 242)
10) Occupational Safety and Health Act, 2007
11) Work Injury Compensation Benefit Act (WIBA), 2007
12) County Governments Act, 2012
13) Physical Planning Act, 1996 (Cap. 286)
14) The Water Act 2002
15) Environmental (Water Quality) Regulations and Standards
16) National Construction Authority Act, 2011
17) Traffic Act (Cap. 403)
18) Penal Code (Cap. 63)
19) National Environmental Policy, 2012
20) Sessional Paper No. 6 of 1999 on Environment and Development
21) World Bank (WB) Safeguard Policies
22) Rio Declaration on Environment and Development (1992)
23) World Commission on Environment and Development (1987)

The project report takes into consideration the requirements of theselegislations and the County Government of Kakamega (CGK) by-laws.The writing of this report was adopted from various similar case studies within and outside the area. The proposed project design was heavily relied on in order to have a clear understanding of the proposed project.

Public participation

Public participation was conducted through interviews with the neighbours, project management and other interested people and parties including the area residents in the neighbourhood of the proposed project site. From the public consultation process it was evident that the people have no objection with the proposed project at the proposed site.

Potential environmental and social impacts

Potential beneficial and adverse environmental and social impacts associated with the proposed project were identified and discussed. The main positive contribution of the proposed project is enhancing sustainable access and storage of water for small scale irrigation, fishing, and other domestic purposes

within the beneficiary community Other benefits include: development of the area, revenue to the governments, increased demand for raw materials, creation of employment opportunities, improved aesthetics, optimal use of land and development in the area. A summary of these potential impacts and a brief description of their mitigation measures have been provided in table I below.

Table I: Summary of potential negative environmental impacts

Area of concern	Proposed mitigation measures
Impact on terrestrial and aquatic ecosystems	• Maintain the demarcation line, and ensure that no personnel or construction materials move outside the designated site • Water quality and aquatic ecosystem monitoring • Any plants or trees of value, close to the rehabilitation area must not be disturbed, defaced, destroyed or removed for the duration
Influx of people and social problems during rehabilitation	• Coordinate and monitor labour and social issues • Carry out initial stakeholder analysis and conduct socio-environmental survey • Ensure that final design does not disadvantage downstream communities. • Educate workers on the cultural sensitivities in the host communities.
Dust and noise	• Regular maintenance of vehicles and machinery used for construction • Limit working to daytime • Contribute to strengthening of local health facilities
Landscaping	• Make safe all borrow pits, quarries and dangerous excavations by backfilling, grading • Monitor backfilled areas for subsidence (as the backfill settles) and fill depressions using available material • Shape all disturbed areas to blend in with the surrounding landscape.
Soil conservation	• Do not strip topsoil when it is wet • Co-ordinate Works to limit unnecessarily prolonged exposure of stripped areas and stockpiles • Excavate and backfill trenches on a progressive basis • Do not stockpile topsoil in drainage lines • Do not stockpile topsoil in heaps exceeding 2 m in height
Creation of habitats for disease vectors	• Monitor the presence of disease vectors • Install a spillway to ensure continuous flows, hence reduced likelihood of creation of habitats for bilharzias
Siltation and sedimentation	• Ensure proper drainage • Establish grass plantation, creepers and trees to prevent washing away of materials from sloped surfaces and along canal banks • Periodic monitoring and clearing silt and sediments • Install sediment traps in fields and canals

Alternatives to the proposed project

Alternatives to the proposed project, site, technologies and construction materials were analyzed based on a cost and benefit criteria; environmental impacts, social acceptability, economics (including

productivity of land-use) and design feasibility and included the following options: no-action, relocation, alternative land-uses and the proposed development.

Environmental Management and Monitoring Plan (EMP)

There is an Environmental Management and Monitoring Plan (EMP) at the end of this report. This plan ensures that environmental impacts are identified and mitigated during all phases of the project.

Recommendations and conclusion

A number of recommendations have been given at the end of the report. The report concludes that if all the suggested mitigation measures are followed and the recommendations put in place, then the proposed project will not adversely impact on the environment.

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1 INTRODUCTION

1.1 Background to the proposed project

The Kenya Climate Smart Agriculture Project (KCSAP) is a World Bank funded project that seeks to sustainably increase agricultural productivity, enhance resilience to climate change risks and reduction in Green House Gas (GHG) emissions.The KCSAP office in collaboration with the County Government of Kakamega wishes to utilize part of the funds on excavation of Inaya Water Pan situated in Marama West Ward in Butere Sub-countyKakamega County. Below is a summary of the proposed project. The proposed project land belongs to Saul LipukuAkala who has voluntarily given out the land to the Butere Mumias Local Vegetables Co-operative Society and the Inaya Community to construct the water pan

Table 1.1: Summary of the proposed project

Item	Description
Project name	Proposed Inaya Water Pan on Plot No.Marama/Lunza/136
Location	Plot No. Marama/Lunza/136 at Inaya Village,Shitali Location, Marama West Ward in Butere Sub-county, Kakamega County
Nature of development	Excavation of a Water Pan
Objective	Enhancing sustainable access and storage of water for small scale irrigation, fishing, and other domestic purposes within the beneficiary community
Target	Inaya Community
Proponent	Kenya Climate Smart Agriculture Project, Kakamega County
Contact person	(+254 723 798 401)
Plot size	0.75Acres
Nature of land ownership	The land belongs to Saul Lipuku Akala who has voluntarily given out the land to the Butere Mumias Local Vegetables Co-operative Society and the Inaya Community to construct the water pan
Neighbourhood	Residential homes, Riverside Primary School, a stream, access roads and un-developed parcels

1.2 General objectives of the project

i. To improve food security through water dam construction;
ii. Promotion of conservation and management of critical and fragile ecosystem within the Inaya Community;
iii. Promotion of production of local vegetables and other related crop for the society;
iv. Develop income and employment generating opportunities through sustainable water catchment ecosystem conservation;
v. Improve sustainable water resources management; and
vi. Resource mobilization and programme development for joint activities aimed at improving income generation and sustainable use and conservation of water resources

1.3 Rationale for the EIA process

1.3.1 Purpose of the EIA

The proposed project is a water pan categorized as a Medium-risk Project under the second schedule of section 58 (1), (5) ofEMCA, 1999 (Cap. 387), amended 2015. Its beneficial and adverse environmental impacts cannot therefore be underestimated. The project requires an EIA carried out for it before it is implemented subject toSection 58 of the Act and Part VI, Section 31 (3) (a) (i) and (ii), of its legislative supplement, the Environmental (Impact Assessment and Audit) Regulations, 2003 which require all upcoming projects to have environmental assessments carried out for them before they are executed. EIA provides baseline information upon which subsequent environmental assessments are based. It also addresses mitigation options for potential impacts. The main purpose of an EIA is therefore to assist the Proponent, NEMA and all other stakeholders in understanding the potential environmental consequences of the project and thus provide a basis for making informed decisions on the project.

1.3.2 Objectives of the EIA

The following are the main objectives:

a) To comply with EMCA,1999 (Cap. 387), amended 2015;
b) To identify and assess the likely negative and positive environmental impacts that would arise with the implementation of the proposed project;
c) To identify and plan for measures for the mitigation of the identified impacts; and
d) To provide a basis for decision-making to reviewers and the Authority.

1.3.3 Terms of Reference (TOR) and scope for the EIA

The assessment is expected to meet the objectives of EIA in order to ensure sustainable development. Hence, TOR outlining the expectations of the EIA were documented by the Proponent and the EIA team in accordance with the requirements of the Environmental (Impact Assessment and Audit) Regulations, 2003 in order to lay a basis for the assessment. The proponent and the EIA team did the following in order to achieve the TOR for this assessment:

a) Generated environmental baseline conditions of the project area.
b) Described the proposed project by giving clear accounts of its location; design; construction and operational activities; material usage; products and by-products including wastes to be generated in all phases and the methods of their disposal; and likely environmental changes.
c) Obtained views and opinions of the interested and affected persons by undertaking public consultations by means of administration of questionnaires to neighbours, business operators and area residents in the vicinity of the proposed project.
d) Reviewed legislations and regulations relevant to the proposed project and showed their relevance to the proposed project.
e) Described and analyzed alternatives to the proposed project in relation the project site, design, technologies, processes and the reasons for preferring the proposed alternative.
f) Established key areas of environmental, health and safety concerns focusing on both the positive and negative effects in relation to how they affect the biophysical, social, economic and cultural components of the environment.

g) Analyzed impacts and recommended mitigation and enhancement measures for the adverse and positive impacts respectively. The analysis of potential impacts related to the location; design; applicable technologies; and construction and operation activities of the proposed project.
h) Generated comprehensive environmental management and monitoring plans for the proposed project covering all its phases. The plans form a basis upon which all mitigation/enhancement measures will be carried out and specify the parties (organizations or individuals) responsible for the implementation of mitigation/enhancement measures and the schedule for their implementation and indicate the parameters to be monitored, frequency of monitoring, indicators of performance, parties responsible for monitoring and the associated costs.
i) Generated a comprehensive EIA report in accordance with the Environmental (Impact Assessment and Audit) Regulations, 2003and submitted the report and necessary soft and hard copies to the Authority for further instructions and/or approval.

1.3.4 Assessment methodology and limitations

This assessment was carried out in March 2019 in accordance with the procedures and protocols in the Environmental (Impact Assessment and Audit) Regulations, 2003. The assessment involved:

a) Extensive site tours to physically inspect and document existing facilities at the site and natural and socio-economic features of importance;
b) Environmental screening to determine the necessity and level of the EIA process;
c) Interviews with the interested and affected persons including the project management team and neighbouring residents and business operators among other groups in the neighbourhood regarding the proposed project; and
d) Desktop studies for documentary review on the nature of the activities of the proposed project, proposed project related documents, plans, designs, policy and legislative frameworks as well as the environmental setting of the area amongst other things.

The main limitation to the assessment is that some of the information was compiled based on responses of the owner and the stakeholders involved. There are difficulties in verification of some of this kind of information. The consultant has evaluated information obtained within the limits of the established scope of work.

2 BASELINE INFORMATION OF THE PROPOSED PROJECT AREA

2.1 Introduction

In this chapter emphasis was placed on describing proposed project area and its neighbourhood in terms of resources, vegetation, land-use patterns, socio-economic activities, population, topography, climate and geology among others so as to provide a basis from which the potential impacts of the proposed project can be predicted. The proposed site is found at Inaya Village, Marama West Ward in Butere Sub-county in Kakamega County.

Figure 2.1: The position of the proposed site
Source: Google maps

2.2 Challenges to development

The area faces a number of environmental challenges including:

a) The increasing population which poses pressure on land resource;
b) Lack of properly defined public solid waste collection and disposal systems;
c) Risk of encroachment into wetlands for agricultural production and inadequate water supply;

Plates 2.1 (a and b): The proposed site during the assessment

Plate 2.2 (a and b): Homesteads to the North of the proposed site (plate a) and a protected spring near the proposed site (plate b)

2.3 Physical environment

2.3.1 Altitude and Climate

The altitude at the project area is about 1,424 m above sea level. The climate of the proposed project site identifies with that of the wider Western Region of Kenya.The wider Western Region experiences a total of about 2,500 hrs of bright sunshine per annum, which is equivalent to annual mean of approximately 6.8 hrs of sunshine per day. July and August are characterized by cloudiness and during these months, the average daily sunshine in the region is 4 hours. The area receives Northeast and Southeast monsoons that blow very steadily but without high intensity. Both wind run and mean wind speed are at a maximum in December and remain high during January, February and March coinciding with the dry season and period of higher potential evaporation. Evaporation is affected by temperature and sunshine factors and has its peak in March.

2.4 Biological environment

It is important to note that there are no ecologically sensitive environments; endangered, rare, keystone or endemic species or wetlands at or near the proposed project site. Butere has no gazetted forests and most of land is under sugar cane plantations, though there are various indigenous trees in some areas. The area has both exotic and indigenous tree species. The trees mainly found in the area include *Croton megalocarpus, Caltisduratii, Anigeria altissimo, Ficusexasperata, Funtumiaclastica* and *Bosqueaphoberos* among others. The trees are used mainly for ornamental, shade, boundary demarcation, fencing and production of fruits. There is high potential for agro-forestry activities due to high rainfall and fertile soils. However, this is limited by land fragmentation and high population growth.

2.5 Physical environment

2.5.1 Climate

The climate of the proposed project site identifies with that of the wider Western Region. Rainfall is spread into two wet seasons; the long rains usually begin from March and end in June while the short rains span from August to October. The peaks occur in May and September respectively. However, there are some variations in the timings due to climate change. The annual rainfall ranges from 1,000

mm to 1,500 mm per year. Temperatures range from 14 ºC to 32 ºC depending on the month of the year. The mean maximum varies from 22 ºC in July/August to 28 ºC in March. Diurnal temperature variations are minimal.

2.5.2 Air quality

Generally, gaseous emissions within the area are visible and are attributed to presence of automobiles such as vehicles and motorcycles. Air quality deterioration is also caused by dust and burning activities taking place in the area especially of solid wastes within the area and in farms and homesteads.

2.5.3 Land formation and soils

Most parts of the neighbourhood have gentle slopes that are covered by vegetation and this helps to prevent loss of soil and soil nutrients through soil erosion. The soils are predominantly loamy fertile soils which have high humus content with high water holding capacity and high nutrient availability and therefore favour crop cultivation an activity carried out by most of the residents in the area.

2.6 Socio-economic information

2.6.1 Population

The neighbourhood of the proposed site is densely populated due to the presence of Lunza Trading Centre. The area is characterized by linear settlement due to business activities along the Lunza - Bukura Road.

2.6.2 Physical and social infrastructure

Electricity in the area is supplied by the Kenya Power. There is no piped water in the area. People access water from protected springs and boreholes. Other sources of water include protected springs, water vendors and harvested rain water. Most homesteads have adopted water harvesting where they have tanks for storing harvested rain water from the roofs by the use of gutters. The area is served by traffic mainly on Bukura – Lunza- Road and many other access roads. Communication is excellent for mobile reception from Safaricom, Airtel, and Telkom networks.

2.6.3 Agriculture

Farming forms a major source of livelihood in the area. The main crops grown are maize, sugarcane, bananas, beans, tea, sweet potatoes and vegetables. Animals kept include poultry, cow, sheep and goats. Farming is mainly concentrated and is extensively practiced in the rural areas.

2.6.4 Business activities and employment in the neighbourhood

Business entrepreneurs licensed in the area include salons, barber shops, hotels and retail shops, carpentry shops, motorbike repairs, wholesale shops, welding, bar and restaurant, distributors different products, bakeries and Mpesa and Airtel Money shops. These businesses provide employment opportunities to many residents in the area. Other sources of employment are government, financial and academic institutions. Banks such as KCB, Family Bank and Cooperative Bank that can offer credit facilities to entrepreneurs are located within Sabatia and Butere Towns that are the nearest town to the proposed project.

3 PROPOSED PROJECT DESCRIPTION

3.1 Project design and components

The proposed reservoir area falls within an agricultural and residential setting. The estimated reservoir capacity of the proposed dam is about 150,000 m^3. The proponent intends to establish a water pan for use by the local community. The community will use the water in the dam for small scale irrigation, fish farming, watering of animals among other uses.Community members have plans to introduce fish in the water pan once the construction exercise is complete. The dam will be fenced and gated to control access.The project will also be installed with pit-latrines and bathrooms for sanitation activities. The community hopes the water pan will act as a spring board for other developments within the area.

3.2 Proposed project activities

3.2.1 Site Clearing

The Contractor shall break up and remove some of the existing obstructions, grub up and remove hedges, bushes and shrubs and clear the site of the works at such time and to the extent required by the Engineer but not otherwise, subject to the provisions of the Conditions of Contract: the materials so obtained shall so far as suitable be reserved and stacked for further use; all rubbish and materials for use shall be destroyed or removed from the site, as directed by the Engineer, standard procedures and guidelines. Site clearing will include top soil removal to a minimum depth of 20cm.

Where top soil will be excavated it shall be removed and stacked on site. After completion of construction, it shall be spread over the disturbed ground, any surplus being disposed of as is discussed in this report.

3.2.2 Excavation

The contractor shall, wherever the engineer considers it practicable, carry out the excavation in such a manner that the suitable materials are placed separately for use in the works without contamination by the unsuitable materials. All excavations shall be kept free from water, from whatever source, at all times during construction of works. Excavations activities involving desilting will go up-to a depth of 2 meters.

3.3 Earthworks and water pan construction

This includes placement and compaction of the water pan fill, grading, and all ancillary items required to prepare the embankment to the design elevations and limits indicated on the drawings.

3.3.1 Pan crest

The Contractor shall provide an embankment crest with un-sieved gravel for the movement of pedestrians and animals without causing erosion of embankment crest.

3.3.2 Spillway

Spillway is a water pan safety valve. A spillway will be sited at a distance of at least 10 m from the ends of a pan wall to avoid flood water eroding the embankment. Further protection from erosion will be achieved by building a low wall of large stones set in mortar along the side of the spillway next to the embankment.

3.4 Catchment protection

3.4.1 Soil conservation

Catchment protection is important in reducing soil erosion and siltation of the reservoirs. The protection will consist of digging cut off drains and planting of trees in rows along the contours. All land-users in at thecatchment area will be encouraged to participate in all the soil conservation activities, including the maintenance of structures and vegetation cover.

The silt traps will reduce the speed of the inflowing water thereby giving soil particles time to settle in and above the silt traps. After flooding, most of the accumulated silt will be removed and used for fertilizing adjacent farmland if possible.

3.4.2 Reservoir protection/hygiene and sanitation components

3.4.2.1 Fencing the reservoir

The proposed reservoir will be gated and fenced with barbed wire to keep off livestock. This will help to maintain better quality water and avoid the risk of livestock and people drowning/polluting the water.

3.4.2.2 Washrooms

At the time of assessment, there were no washrooms at the proposed reservoir site. The proponent plans to establish some at the proposed project site. This is intended to maintain water quality at the water pan particularly free from fecal pathogens that may result from open defecation in the fields around the water pan. To prevent contamination of dam reservoirs by people washing clothes and bathing directly in the water reservoirs, strict measures will be put in place to avoid water contamination through bathing and washing clothes in the water reservoirs.

3.4.2.3 Cattle trough

The proponent will also construct a water trough for watering of animals. The water trough will be located downstream of the dam to prevent contamination of the dam by livestock during watering.

3.5 Project materials, storage and equipment

3.5.1 Materials and equipment

Earth moving equipment including excavators, tractors, trucks, Grader, Dozer/excavator Loader, Tractor/Dump, Truck, Water truck among other will be used. All materials and equipment furnished under the contract shall be constructed and finished in a workman like manner. Materials shall be suitable for the service intended and selected and fabricated in accordance with the best engineering practice. Material shall be environmentally clean and free of refuse, debris, organic matter, and miscellaneous or deleterious materials

3.5.2 Material Storage and Job Sites

The Contractor shall construct secure fences and provide guards to ensure the security of the materials storage yards and all fixed job sites. Open trenches shall have barricades around them to prevent people or cars from accidentally falling in at night.

3.6 Proposed project products

The proposed water pan project will result in a desiltedpan for water harvesting and storage, a protected water point for clean water supply for domestic use and pit latrines and bathrooms for sanitation purposes and a water trough for watering animals. The site will also be fenced and gated to regulate access.

3.6.1 Irrigation component

The proposed water pan will be used for small scale irrigation by the neigbouring community members. The irrigation system is planned to be operated during the critical months of water shortage periods. The runoff harvested during the rainy season will be stored in the reservoir for irrigation use.

3.6.2 Fish farming

The proposed reservoir will be used for fish farming. The community also has plans to establish more fish ponds downstream of the proposed reservoir.

3.6.3 Protected water point for domestic use and drinking

The proposed project exercise has a component of a protected water point. The water point will be protected to provide alternative clean water supply for domestic use by the residents.

3.7 Description of the proposed project activities

The Proponent is advised not to start the construction of the proposed water pan until the EIA project report is reviewed and the EIA license issued. If approved and licensed, the proposed project has three main overlapping phases: construction, operation and decommissioning. A summary of the main activities under each phase of the proposed projects has been given (Table 3.1).

Table 3.1: Description of the phases of the proposed project

Phase	Main activities
Construction	a) Site preparation and mobilization of construction personnel, equipment and construction material b) Removal of vegetation, rubbish and unwanted and/or old structures from the construction site c) Excavation and water pan development d) Use of machinery, hand tools and equipment and employment of human labour e) Installation of utilities and equipment f) Environmental management as stipulated in this report
Operation	a) Commissioning the completed project for use of as a water reservoir b) Repair and maintenance of the water pan c) Environmental management as stipulated in this report
Decommissioning	a) Demolition and/or change of use b) Rehabilitation and/or restoration

3.8 Technology and machines to be used

The contractor will employ modern and best technologies which will not be inferior to locally and internationally established standards. Hand tools, equipment and machines will be used in the construction. These machines will include excavators, concrete mixers; power vibratorsfor strengthening bases; plate compactors for stabilizing; and. Hand tools will include *jembes, pangas*, shovels, spades, hammers, axes and general building hand tools.

3.9 Construction material handling

Most construction works take in considerable amounts of artificial and natural material. The materials to be used have to conform to KEBS requirements for quality. A store can be made of iron sheet walling and roof. A caretaker will be employed at the site. Handling of all hazardous chemicals will be done in accordance with their manufacturers' instructions as outlined on their material safety data sheets. Usage of materials has both beneficial and adverse impacts on the environment. Both on-site and off-site

impacts are also anticipated from extraction and usage material. The most common of these impacts are income circulation in the economy, creation of employment opportunities, off-site depletion of materials, land degradation, pollution, excessive demand on materials and health hazards.Sources of construction materials depend on the contractual agreements between the Proponent and the contractors, their availability and the priorities of the person sourcing the material.

4 RELEVANT LEGISLATIVE AND REGULATORY FRAMEWORK

4.1 Introduction

There is need to take care of the environment in order to ensure survival of human beings. The law has intervened to ensure that human beings are considerate, cautious and careful in their dealings with the environment. The laws governing the environment in Kenya include the constitution of Kenya, 2010; EMCA, 1999 (Cap. 387), amended 2015and its subsidiary legislations; and other Kenyan and multilateral environmental laws. EMCA, 1999 (Cap. 387), amended 2015was developed to harmonize and co-ordinate environmental management issues in Kenya by providing for the establishment of an appropriate legal and institutional framework for the management of the environment. The institution is NEMA. The Act covers all aspects of the environment. Kenya is a signatory to some international legislation. Some of these are relevant to this project and were reviewed for the purpose of writing this report. Environmental management issues are addressed differently in several legal statutes, but the main objective in all of them is sustainability. It is however noted that wherever any of the laws contradict each other, EMCA, 1999 (Cap. 387), amended 2015prevails.

4.2 Institutional framework

4.2.1 National Environmental Management Authority (NEMA)

EMCA, 1999 (Cap. 387), amended 2015 provides for establishment of NEMA as the principal agency responsible for coordination, monitoring and supervision of environmental issues in Kenya. NEMA too has a cross-sectorial mandate to oversee the conduct of environmental assessments and audits through issuance of guidelines, regulations and registration of environmental practitioners. It reviews and approves reportsfor environmental assessments and audits in consultation with any relevant lead agencies.NEMA's enforces environmental legislations through the Department of Compliance and Enforcement which is responsible for ensuring that projects comply with the various environmental regulations and standards. NEMA has appointed environmental inspectors whose powers and duties are listed out under section 117 of EMCA, 1999 (Cap. 387), amended 2015. The environmental inspector may also issue an improvement notice requiring an operator to cease any activity deleterious to the environment which are contrary to the Act. NEMA has power, to prosecute environmental offenders and offences committed under the Act and may earn the offender fines and prison sentences. NEMA works with the county environment departments and committees at the county level in undertaking inspection, monitoring and compliance enforcement.

Relevance: NEMA will review and approve this EIA report. County environment officers represent NEMA at the county level and are responsible for monitoring environmental protection or regulatory compliance at the county level. In this regard, Kakamega County NEMA office is expected to monitor regulatory compliance of the proposed project throughout its life cycle.

4.2.2 Environmental liaison units in other institutions with environmental management mandates in Kenya

NEMA is linked to sectorial lead agencies, private organizations and educational institutions through their environmental liaison units. These institutions include county environment departments, parastatals, learning institutions, NGOs and CBOs among others and are charged with implementation of environmental programmes and integration of environmental concerns in sectorial policies, plans and programs. Consequently, they monitor investment programmes at their respective sectorial levels.

Relevance: Relevant environmental liaison units are stakeholders in the proposed project and will have input into the EIA process.

4.3 Laws, regulations, codes andpoliciesof Kenya with environmental relevance

4.3.1 The Constitution of Kenya, 2010

This is the sovereign law in Kenya. The constitution acknowledges the people of Kenya's respect for the environment which is our heritage in its preamble. It also points out our determination to sustain it for the benefit of future generations. This is sustainability of the environment.Environmental provisions are included in:

- Cap. 4 on Rights and Fundamental Freedoms
- Cap. 5 on Environment and Natural Resources
- Cap. 10 on Judicial Authority and Legal System
- Fourth Schedule on Distribution of functions between National and County Governments
- Fifth Schedule on Legislation to be enacted by Parliament

Chapter 5, Part 2 has the following provisions on Environment and Natural Resources

- Article 69 – Obligations in respect of the environment
- Article 70 – Enforcement of environmental rights
- Article 72 – Legislation relating to the environment

Article 42 states that, "Every person has a right to a clean and healthy environment, which includes the right to:

a) Have the environment protected for the benefit of the present & future generations through legislative & other measures, particularly those contemplated in Article 69; and
b) Have the obligations relating to the environment fulfilled under Article 70

Relevance: This is the sovereign law in Kenya and points out our determination to sustain the environment it for the benefit of future generations. The Proponent must be committed to protecting the environment throughout the project life cycle.

4.3.2 Environmental Management and Coordination Act, 1999 (Cap. 387), amended 2015

It is a requirement that all projects listed under the second schedule of the Act undertake an environmental assessment and submit a report to NEMA for licensing before commencement. The subsidiary legislation to the Act, the Environmental (Impact Assessment and Audit) Regulations, 2003provides the framework for carrying out EIAs and EAs in Kenya by NEMA licensed experts. EIAs should be followed by EAs which should be carried out to annually to determine the projects' compliance with environmental regulations.

Section 3 (1) of the Act states that, "Every person in Kenya is entitled to a clean and healthy environment in accordance with the Constitution and relevant laws and has the duty to safeguard and enhance the environment".

Section 58 (1) of the Act states that, "Notwithstanding any approval, permit or license granted under this Act or any other law in force in Kenya, any person, being a proponent of a project, shall before any financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeded with, carried out, executed or conducted by another person any undertaking specified in the Second Schedule to this Act, submit a project report to the Authority, in the

prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee". This fee is determined by the Authority.

Section 68 (3) states that, "The owner of the premises or the operator of a project for which an environmental impact assessment study report has been made shall keep accurate records and make annual reports to the Authority describing how far the project conforms in operation with the statements made in the environmental impact assessment study report submitted under section 58(2)."

Relevance: The Proponent is carrying out this EIA in order to comply with sections 58 to 67 and 138 of the Act. The Proponent shall keep records of environmental issues, relevant licenses and permits and shall avail them to the Authority when necessary to prove compliance. The Proponent shall also be held responsible for any other matter in contravention of this Act.

4.3.3 Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009.

This Act applies to all wetlands in Kenya whether occurring in private or public land. It contains provisions for the utilization of wetland resources in a sustainable manner compatible with the continued presence of wetlands and their hydrological, ecological, social and economic functions and services.

Relevance: The proposed dam project is an important source of water to the local community. The proponent shall comply with the provisions of the Act in protecting wetlands, preventing and controlling pollution and Siltation in rivers.

4.3.4 The Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006

The Act states that no person shall not engage in any activity that may have an adverse impact on any ecosystem, lead to the introduction of any exotic species, or lead to unsustainable use of natural resources, without an Environmental Impact Assessment License issued by the Authority under the Act.

Relevance: The Proponent has commissioned this environmental assessment study and seeks to obtain an EIA License from the Authority (NEMA) in compliance with the Act; the environmental management plan included in this report provides guidelines for the mitigation of potentially adverse impacts on natural resources.

4.3.5 Fisheries (General) Regulations, 2012

Protection of marine mammals and turtles

(1) The maritime zones of Kenya are declared to be a marine mammal and turtle sanctuary.

(2) No person shall—

(a) Kill any marine mammal or turtle;

(b) Chase any marine mammal or turtle with intent to kill;

(c) Harass any marine mammal or turtle so as to disturb its behaviour or breeding habits; or

(d) Take any marine mammal or turtle, alive or dead, including any marine Mammal or turtle stranded on land.

(4) Any person who contravenes this regulation shall be guilty of an offence and liable to a fine not exceeding twenty thousand shillings or to imprisonment for a term not exceeding two years or to both.

4.3.6 The Irrigation Act, Cap 347 (Revised Edition 2012)

Functions and powers of the Board

(1) The Board shall be responsible for the development, control and improvement of national irrigation schemes in Kenya.

(2) The Board shall have and may exercise all such powers as are necessary to enable it to perform its functions under this Act, and. without prejudice to the generality of the foregoing, the Board shall have power among other to;

a. To design, construct, supervise and administer national irrigation schemes;
b. To conduct research and investigation into the establishment of national irrigation schemes.

4.3.7 Environmental Management and Coordination (Noise and Excessive Vibration, and Pollution Control) Regulations, 2008

These regulations prohibits under Section 3 (1) the causing of loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Noise levels as provided for in the First Schedule of these regulations are presented in table 4.1 below.

Table 4.1: Maximum permissible intrusive noise levels

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

Source: First Schedule of the Environmental Management and Coordination (Noise and Excessive Vibration, and Pollution Control) Regulations, 2008

According to these regulations, Day means the time between0601 hoursand2000 hours while night the time between 2001 hours and 0600 hours. In compliance with these regulations:

a) Super-silent generators will be used;
b) There will be no construction at night;
c) Ear muffs will be provided to workers during construction;
d) Regular maintenance/repair of contractor's vehicles and machinery will be enforced in order to minimize vibrations and noise;
e) Any maintenance of construction vehicles and machinery will be carried out in the contractor's yard that may be onsite or off site; and
f) The construction site will be enclosed in accordance with NCA requirements to minimize noise levels emanating from the construction site.

Relevance: All noise to be produced at the proposed site in all its phases shall be managed in accordance with the guidelines in this report or from other authorities in control of noise. The

Proponent shall be held responsible for any environmental nuisance resulting from noise pollution at the proposed site and for any other matter in contravention of these regulations.

4.3.8 Environmental Management and Coordination (Waste Management) Regulations, 2006

According to part II of the regulations, a generator of waste should:

a) *Not dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle;*
b) *Collect, segregate and dispose or cause to be disposed-off such waste in the manner provided for under these Regulations; and*
c) *Ensure that the waste is transferred to a person who is licensed to transport and dispose-off such waste in a designated waste disposal facility.*

Relevance: All wastes from the proposed site will be managed in accordance with the procedures outlined in this report or as may be advised by the public health office and/or other authorities. The Proponentand contractor(s) will be held responsible for any environmental damage or nuisance resulting from wastes from the proposed project and site and for any other matter in contravention of these regulations.

4.3.9 Public Health Act, 1986 (Cap. 242)

Part IX of the Act on Sanitation and Housing, Section 115 prohibits nuisance by stating that, "No person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health."

Section 118 (b) – (i), (p) – (q) and (s) defines nuisance in that order as:

- Any dwelling or premises or part thereof which is or are of such construction or in such a state or so situated or so dirty or so verminous as to be, in the opinion of the medical officer of health,
- injurious or dangerous to health, or which is or are liable to favourthe spread of any infectious disease;
- Any street, road or any part thereof, any stream, pool, ditch, gutter, watercourse, sink, water-tank, cistern, water-closet, earth-closet, privy, urinal, cesspool, soak-away pit, septic tank, cesspit, soil-pipe, waste-pipe, drain, sewer, garbage receptacle, dust-bin, dung-pit, refuse-pit, slop-tank, ash-pit or manure heap so foul or in such astate or so situated or constructed as in the opinion of the medical officer of health to be offensive or to be injurious or dangerous to health;
- Any well or other source of water supply or any cistern or other receptacle for water, whether public or private, the water from which is used or is likely to be used by man for drinking or domestic purposes or in connection with any dairy or milk shop, or in connection with the manufacture or preparation of any article of food intended for human consumption, which is in the opinion of the medical officer of health polluted or otherwise liable to render any such water injurious or dangerous to health;
- Any noxious matter, or waste water, flowing or discharged from any premises, wherever situated, into any public street, or into the gutter or side channel of any street, or into any nullah or watercourse, irrigation channel or bed thereof not approved for the reception of such discharge;

- Any stable, cow-shed or other building or premises used for keeping of animals or birds which is so constructed, situated, used or kept as to be offensive or which is injurious or dangerous to health;
- Any animal so kept as to be a nuisance or injurious to health;
- Any accumulation or deposit of refuse, offal, manure or other matter whatsoever which is offensive or which is injurious or dangerous to health;
- Any accumulation of stones, timber or other material if such in the opinion of the medical officer of health is likely to harbour rats or other vermin;
- Any premises in such a state or condition and any building so constructed as to be likely to harbour rats;
- Any dwelling or premises which is so overcrowded as to be injurious or dangerous to the health of the inmates, or is dilapidated or defective in lighting or ventilation, or is not provided with or is so situated that it cannot be provided with sanitary accommodation to the satisfaction of the medical officer of health;
- Any public or other building which is so situated, constructed, used or kept as to be unsafe, or injurious or dangerous to health;
- Any occupied dwelling for which such a proper, sufficient and wholesome water supply is not available within a reasonable distance as under the circumstances it is possible to obtain;
- Any area of land kept or permitted to remain in such a state as to be offensive, or liable to cause any infectious communicable or preventable disease or injury or danger to health;
- Any chimney sending forth smoke in such quantity or in such manner as to be offensive or injurious or dangerous to health; and
- Any act, omission or thing which is, or may be, dangerous to life, or injurious to health.

Relevance: The Proponent shall be held responsible for any nuisance defined under section 118 resulting from the proposed site and for any other matter in contravention of this Act.

4.3.10 Occupational Safety and Health Act, 2007

This Act provides for the safety, health and welfare of workers and all persons lawfully present at workplaces where any person is at work, whether temporarily or permanently. Part II of the Act on General Duties states the following:

- Duties of occupiers according to: Section 6 (1) that,"Every occupier shall ensure the safety, health and welfare at work of all persons working in his workplace".
- Section 6 (2) (b), "Arrangements for ensuring safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances".
- Section 6 (2) (c), "The provision of such information, instruction, training and supervision as is necessary to ensure the safety and health at work of every person employed".

Part VI, Sections 47 to 54 on Health General Provisions requires work places to be kept clean, properly ventilated, have enough lighting, have floors properly drained and have sanitary conveniences.

Relevance: The contractor(s) and the Proponent will ensure the safety and health of those to be employed at the site in all its phases. They will also be held responsible for any other matter in contravention of this Act. The EMPprovided advises the Proponent and the contractor(s) on safety and health aspects, potential impacts, personnel responsible for implementation and

monitoring, frequency of monitoring, and estimated cost, as a basic guideline for the management of health and Safety issues.

4.3.11 Work Injury Compensation Benefit Act (WIBA), 2007

This Act provides for compensation for employees on work related injuries and diseases contacted in the course of employment and for connected purposes. The Act includes compulsory insurance for employees. The Act defines an employee as any worker on contract of service with employer.

Relevance: The proponent will ensure all contractor(s) have insured the staff involved in the construction. Compensation will be undertaken for any employee in cases of injury or disease in line with working.

4.3.12 County Governments Act, 2012

This Act gives effect to chapter eleven of the Constitution of Kenya to provide for county governments powers, functions and responsibilities to deliver services and for connected purposes.

Relevance: The proposed site is found in Kakamega County.The Proponentwill abide by all laws, rules, regulations, guidelines and requirements by the CGK. The contractor and the Proponent will be held responsible for any other matter in contravention of this Act.

4.3.13 Physical Planning Act, 1996 (Cap. 286)

This Act makes specific provisions for physical planning. Section 25 (b) of the Act states that, "A local physical development plan shall consist of such maps and description as may be necessary to indicate the manner in which the land in the area may be used".

Relevance: The Proponentwill be held responsible for any matter in contravention of this Act and in breaking regulations by the Physical Planning Department of Kakamega County.

4.3.14 The Water Act 2002

The Water Act, 2002 provides the legal framework for the management, conservation, use and control of water resources and for the acquisition and regulation of right to use water in Kenya. It also provides for the regulation and management of water supply and sewerage services. In general, the Act gives provisions regarding ownership of water, institutional framework, national water resources, management strategy, and requirement for permits, state schemes and community projects. Part IV of the Act addresses the issues of water supply and sewerage. Specifically, section 59 (4) of the Act states that the national water services strategy shall contain details of:

Existing water services

- The number and location of persons who are not being provided with basic water supply and basic sewerage
- Plans for the extension of water services to underserved areas
- The time frame for the plan; and
- An investment programme

Part II, section 18, of the Water Act 2002 provides for national monitoring and information system on water resources. Following on this, sub-section 3 allows the Water Resources Authority (WRA) to demand from any person or institution, specified information, documents, samples or materials on water

resources. Under these rules, specific records may require to be kept by a facility operator and the information thereof furnished to the Authority**.**

a.) The Water Resources Management Rules, 2007

As a subsidiary to the Act, a legislative supplement, The Water Resources Management Rules, 2007 was gazetted to guide all policies, plans, programmes and activities that are subject to the Water Act, 2002. The Water Resources Management Rules empower Water Resources Management Authority (WRMA) to impose management controls on land use falling under riparian land.

4.4 Environmental (Water Quality) Regulations and Standards

4.4.1 Protection of Drinking Water Sources- Rivers, Streams and Lakes

National Environment Management Authority (NEMA) has proposed regulations in order to protect drinking water sources. For the protection of rivers, streams and lakes, no person shall:

- Discharge, any effluent from sewerage treatment works or industry, that exceeds the discharge standards proposed.
- Carry out any activity near rivers, streams and lakes without an EIA license in accordance with the Environmental (Impact Assessment and Audit) Regulations, 2003;
- Abstract water from rivers, lakes and streams without a valid license from the water service board in accordance with the Water Act, 2002.

4.4.2 Water Quality Monitoring

For the protection of drinking water sources, the Ministry responsible for the water affairs, in consultation with the Authority, shall maintain regular water quality monitoring twice a year, once during low flow, and once during high flow period, as stipulated in the Water Act, 2002, Part III Section 18, schedule 17. Table (b) below shows the parameters and results to be looked at when monitoring the water quality for drinking water sources.

Table: Water Quality Monitoring for Drinking Water Sources

Parameter	Standard Results
pH	6.5-8.5
Suspended solids	30 (mg/L)
Nitrate – NO_3	10 (mg/L)
Ammonia – N	0.5 (mg/L)
Nitrate – NO_2	3 (mg/L)
Total Dissolved Solids	1200 (mg/L)
E-Coli	Nil/100ml
Fluoride	1.5 (mg/L)
Phenols	Nil (mg/L)
Arsenic	0.01 (mg/L)
Cadmium	0.01 (mg/L)
Lead	0.05 (mg/L)
Selenium	0.01 (mg/L)
Copper	0.05 (mg/L)
Zinc	1.5 (mg/L)

Alkyl benzyl sulphonates	0.5 (mg/L)
Permanganate Value	1.0 (mg/L)

Source: National Environmental Management Authority

4.4.3 National Construction Authority Act, 2011

The National Construction Authority (NCA) was established under an Act of parliament to oversee the construction industry and coordinate its development. Section 15 (1) of the Act states that, "A person shall not carry on the business of a contractor unless the person is registered by the Board under this Act".

Relevance: The Proponentwill select a contractor(s) who is/are registered with NCA. The proposed project will be registered in accordance with NCA requirements. NCA will ensure that the proposed project is constructed in accordance with laid down building standards and will be held responsible for any other matter in contravention of this Act.

4.4.4 Traffic Act (Cap. 403)

This is an Act of Parliament to consolidate the laws relating to traffic on the roads. Section 66 A (1) of the Act protects the occupational safety and health of drivers by stating that, "*No person shall drive a public service vehicle or a commercial vehicle for more than a total of eight hours in any period of twenty-four hours".* All drivers who will drive vehicles to be used in the proposed project in all its phases shall operate in shifts of not more than 8 hrs in any period of 24 hrs.

Relevance: The contractor(s) and the Proponent will ensure that all drivers that will be used to mobilize materials at the construction site comply with all traffic rules.

4.4.5 Penal Code (Cap. 63)

The chapter on "Offences against Health and Conveniences" contained in the Code enacted in 1930 strictly prohibits the release of foul air into the environment, which affects the health of other persons.

Relevance: All wastes from the proposed site will be managed in accordance with the procedures outlined in this report or as may be advised by the public health office and/or other authorities. The Proponent will provide appropriate solid and liquid waste handling facilities for the proposed project throughout its project life cycle and will be held responsible for any environmental damage or nuisance resulting from wastes from the proposed project and site and for any other matter in contravention of this Code.

4.4.6 National Environmental Policy, 2012

Integration of environmental conservation and economic activities in the development process is a key policy statement in this policy paper.

Relevance: Throughout the proposed project life cycle, the Proponent will conserve the environment. Conservation measuresat the proposed site will include a well-designed landscaping programme which will involve planting appropriate plants.

4.4.7 Sessional Paper No. 6 of 1999 on Environment and Development

The policy paper emphasizes that EIA must be undertaken by the developers as an integral part of a project preparation. It also proposes for periodic environmental auditing to investigate if developer is fully mitigating the impacts identified in the assessment report.

Relevance: The carrying out of this EIA and the preparation of this report is in compliance with this paper.

4.5 International framework

4.5.1 World Bank (WB) Safeguard Policies

The objective of the World Bank's environmental and social safeguard policies is to prevent and mitigate undue harm to people and their environment in the development process. The Proponent has carried out this EIA in compliance with Safeguard Policy 4.01 that deals with environmental assessment. The Safeguard Policy 4.12 relates to Involuntary Resettlement. No persons, businesses or facilities will be displaced from the proposed site.

Relevance: The Proponent will put in place mitigation measures outlined in this report and as will be advised through improvement orders in order to protect people and the environment from undue harm.

4.5.2 Rio Declaration on Environment and Development (1992)

Principle No. 10 of the declaration underscored that, "Environmental issues are best handled with participation of all concerned citizens at all the relevant levels.

Relevance: The Proponentencouraged and facilitated public participation at the site. Public comments must be treated with utmost relevance.

4.5.3 World Commission on Environment and Development (1987)

This commission commonly referred to as "the Brundtland Commission" focuses on the environmental aspects of development, with particular, the emphasis on sustainable development that produces no lasting damage to the biosphere and to particular ecosystems.

Relevance: The Proponent will put in place mitigation measures outlined in this report and as will be advised through improvement orders in order to protect people and the environment from undue harm.

5 PUBLIC PARTICIPATION

5.1 Introduction

Members of the public are supposed to participate and get involved in decision making concerning development projects because they affect them. Reference is made to Section 17 of the Environmental (Impact Assessment and Audit) Regulations, 2003, which states that the Proponent shall in consultation with the authority, seek the views of persons who may be affected by the projects. The role of public consultation and involvement in EIA process is to assure the quality, comprehensiveness and effectiveness of the assessment and ensure that the public views are adequately taken into consideration in decision making process. This public participation was conducted by administration of questionnaires to the neighbours of the proposed site and residents in the area.

5.2 Findings

The people interviewed greatly appreciated that the Proponent had given them a chance to participate in the decision-making process concerning the proposed project. Most members of the public interviewed were positive about the project.

In summary, the public consultation exercise affirmed support by the local community towards rehabilitation of the proposed dam. The water pan is envisaged tocatalyze the economic development activities in the local community both at rehabilitation and operation phases. The locals cited employment opportunities, irrigation of their kitchen gardens, reduced distance in accessing water, fishing opportunities, improvement in sanitation and eco-tourism among others as the benefits that would directly accrue from the completed project.

A summary of issues that were raised during the public consultation process and views and comments of the members of the public has been given (Table 5.1). These comments can be verified from the public participation comment sheets that are attached on this report.

6 POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 Introduction

The environmental baseline information collected and the project characteristics discussed form the basis for impact identification and evaluation. Assessment of impacts depends on the nature and magnitude of the activities being undertaken as well as the type of environmental control measures that are envisaged as part of the project proposal. The impacts that are expected to arise from the proposed project could either be termed as positive or negative, direct or indirect, short-term or long-term, temporary or permanent depending on their nature, area of coverage and their duration in the environment. Impacts have been identified and discussed in all phases of the proposed project cycle; pre-construction, construction, operational and decommissioning. At the time of the assessment, there were no infringements at the proposed project site that would require relocation.

6.2 Potential adverse impacts during the construction phase

During the construction phase, the following operations and processes are likely to result into significant impacts: biodiversity loss; excavation; movement of machinery; water and energy resource-use and solid and liquid waste management.

6.2.1 Biodiversity loss

6.2.1.1 Assessment

Vegetation at the proposed site consists mainly of forbs and short grasses. There is a rich diversity of fauna mainly arthropods whose life is depended on the water that is at the proposed dam site for shelter and food. Most of the plants must be cleared during excavation to pave way for distillation exercise. With the removal of flora and fauna, several species of plants and animals will be threatened with local-scale extinction and/or displacement. Habitats of these animals will be altered or destroyed by the di-siltation process. Loss of vegetation from the site also means loss of valuable food for these animals leading to eventual death and/or displacement. Moving vehicles, machines and people used for the work will create additional damage to vegetation. Pressure will be exerted on the plants by the heavy vehicles, machines and people and this pressure may interfere with biological processes in the plants alongside leading to death of the plants.

6.2.1.2 Mitigation

It is impossible to totally avoid plant and animal removal and disturbance during the construction phase. It is however important to ensure that any removal and/or disturbance is restricted to particular areas to avoid spill-over effects to other areas and that the same areas are restored later by:

a) Ensuring proper demarcation of the project area to be affected by the construction works.
b) Strictly controlling storage of construction materials over designated areas to minimize destruction of vegetation.
c) Re-establishing vegetation (ornamental plants and hedges) in whole or part of the disturbed areas through implementation of a well-designed landscaping programme. Part of the topsoil excavated from the site can be re-spread in areas to be landscaped to enhance plant health.
d) Ensure clearing of vegetation is restricted to only marked areas
e) If native fauna species are discovered contact wild life department for further instructions
f) Any unexpected finds of potential archaeological significance shall be reported to the Kenya National Museum, and construction works will be ceased until permission is granted to proceed

6.2.2 Soil erosion

6.2.2.1 Assessment Findings

Mobilization of heavy machinery to site for earth movement and leveling will cause instability of the soil in the area and as a result cause soil erosion mainly of top soil. During operation of heavy machinery for earth movement and leveling, soil in the area will be disturbed and as a result cause soil erosion mainly of top soil. Consequently, this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

6.2.2.2 Mitigation Measures

Soil erosion mainly of top soil may lead to sedimentation of reservoir if not checked could reduce the storage capacity of the dam. To avoid this, the proponent needs to;

i. Ensure a buffer zone is created between the water front and occupied areas of human settlement and agricultural activities.
ii. Avoid unnecessary clearing of the vegetation
iii. Limit use of heavy machinery to designated areas
iv. Rehabilitate heavily disturbed areas
v. Install silt fences, sandbags and/or hay bales where required down gradient of disturbed areas, base of embankments, existing drainage lines, earthworks and stockpiles
vi. Plant indigenous trees 2-3m apart around the dam to stabilize the sides/banks within the shortest time possible after completion of rehabilitation works
vii. Heavy plant and vehicle movements will be restricted to hard surfaces after significant rain events
viii. Conduct daily inspection of erosion & sedimentation control measures including after rainfall.

6.2.3 Hazardous waste management

6.2.3.1 Assessment Findings

Use of machinery which is not well maintained or serviced may lead to leakages thus polluting soils and consequently water resources.

6.2.3.2 Mitigation Measures

Not well maintained or serviced machinery usage may lead to leakages thus polluting soils and consequently water resources. To minimize this;

i. Ensure all machinery and equipment is regularly maintained
ii. No vehicle maintenance, and non-operational/routine plant or equipment maintenance, will be conducted on-site
iii. Dispose any used oil at a designated place in accordance with the law
iv. Keep an inventory of oil spills during road construction period
v. Monitor water sources in close proximity dam for oil spills once every month

6.2.4 Land dereliction

6.2.4.1 Assessment Findings

Since the water pan to be constructed is an embankment pan, gravel may be obtained within the project area for the embankment. Barrow pits may also lead to instability of the soil in the area and as a result cause soil erosion mainly of top soil. Borrow pits may lead to limited loss of some wildlife habitat for

small fauna and flora. As a result, loss of vegetation due to land clearance, land degradation due to excavation works and dust are expected.

6.2.4.2 Mitigation Measures

No historical or cultural sites are expected to be lost. However, agricultural land will be affected though relatively of low significance. Mitigation measures will include;

i. Rehabilitation of affected areas through reforestation
ii. Restrict movement of vehicles and equipment to designated areas
iii. Restrict clearance of vegetation to critical areas
iv. Remove all stockpiles and overburden
v. Stabilize all slopes and unstable areas.
vi. Maintain drainage at the dam site

6.2.5 Embankment wall

6.2.5.1 Assessment Findings

The proposed water panwill have a wall height of 3m. No households are expected to be relocated due to inundation resulting from dam and spillway construction. No mitigation is required for loss of historical and cultural sites since none are located within the impoundment area. The project area has been subjected to years of human agricultural activities and as such not much wildlife habitat, flora and fauna is left. Therefore this impact will be low.

6.2.5.2 Mitigation Measures

Measures to be put in place include;

i. Limit clearance of vegetation only to critical areas
ii. Conduct awareness campaigns among staff and community on the need to conserve nature
iii. Adopt strict good conservation practices

6.3 Impacts crosscutting construction and operation

There are some impacts that will cross cut construction and operation phases of the proposed water panproject. They are discusses as follow.

6.3.1 Waste management

6.3.1.1 Assessment Findings

During the construction and operation stage solid waste is expected resulting from land clearance and leveling and excavation. However much of the earth and rubble will still be used in the erection of the dam wall. In addition, human activity involving workers will also result into waste being generated. Water pollution due to indiscriminate disposal of waste may lead to water borne diseases.

6.3.1.2 Mitigation Measures

Solid waste in form rubble and litter is expected during construction. The proponent should ensure that;

i. Waste should be collected at selected points for proper disposal at a designated area
ii. Some of the rubble should be used for compaction in the construction of the water pan wall
iii. Encourage the community to have their own household pit latrines

iv. Conduct awareness campaigns among the staff and the community
v. Discourage open air incineration of solid wastes;
vi. Put in place an efficient waste management system that will prevent the accumulation of uncontrolled wastes, as well as an efficient collection system and off-site disposal; and
vii. Ensure the collection and disposal of the wastes is done regularly and appropriately
viii. Put in place an efficient waste management system that will prevent the accumulation of uncontrolled wastes, as well as an efficient collection system and off-site disposal

6.3.2 Creation of habitats for disease vectors

6.3.2.1 Assessment Findings

The most common vector disease within the proposed project site is Malaria. Construction of the proposed water pan will create conducive habitats for disease carriers such as mosquitoes and snails responsible for spreading diseases such as malaria and schistosomiasis (*Bilharzia*).

6.3.2.2 Mitigation Measures

Assess ecology of disease carriers in the project area, and employ suitable prevention and mitigation measures, e.g.:

i. Monitor the presence of disease vectors
ii. Install a spillway to ensures continuous flows, hence reduced likelihood of creation of habitats for bilharzias is remote
iii. Encourage people in the vicinity of the proposed site to use mosquito nets

6.3.3 Change in stream flow regime, morphological features and water quality

6.3.3.1 Assessment Findings

Construction of the proposed water pan may affect variations in discharges and water levels. The discharge regime may become more regular compared to the conditions without dam and both low and high discharges may occur less frequently. Hydrological changes in the river system may lead to greater area of influenced both upstream and downstream. The stream morphological features may also change with time. During construction, waste in form of rubble and other forms may cause pollution to water quality that can affect downstream users. Therefore, construction of the proposed water pan (reservoir) implies creation of a new environment, developing its own typical water quality problems that may affect the downstream section to some extent.

6.3.3.2 Mitigation Measures

To mitigate changes in stream flow regime, morphological features and water quality, the proponents may consider the following mitigation options;

i. Ensure that the design has adequate design provisions to allow flow downstream even in times of dry months.
ii. Apply standard dam operational rules
iii. Observe water right permit regulations and requirements for the sake of downstream users
iv. Avoid discharge of any waste effluent into the dam
v. Conduct awareness on invasive aquatic weeds

6.3.4 Socio-economic and cultural

6.3.4.1 Assessment Findings

Construction and operation of a water pan will create opportunities for jobs mainly for the local communities. At preparatory and construction stage, local people will be engaged and consequently livelihood for family members will be guaranteed. During the construction, skilled personnel will add on to the local population. There is also a possibility that the community will receive an influx of labourers looking for employment which will further add on to the local population. The operation of the pan may result in increased economic activity in the area consequently more people will be attracted to the area. This may expose the community to foreign people who may lead to the spread of HIV/AIDS and other STIs.

6.3.4.2 Mitigation Measures

The proponent will consider the following mitigation measures;

i. Take a precautionary measure i.e. should any effect of historical nature be discovered during construction, relevant authorities will be notified immediately.
ii. Local people should be given priority for employment particularly as casual laborers
iii. Ensure adequate facilities are provided for staff such as sanitation facilities
iv. Promote formation of small holder schemes to be run by small scale farmers within the community
v. Sensitize staff and community on the dangers of HIV/AIDs and STIs

6.3.5 Impacts related to occupational health and safety

6.3.5.1 Assessment

There are three main types of occupational health and safety hazards that may be of concern in any proposed development namely physical, chemical and biological. Potential physical hazards at the proposed development during the construction and operational phases will ordinarily include noise and accidents among others. Chemical hazards will involve exposure to hazardous materials either by inhalation, ingestion or by skin contact. Biological hazards involve exposure to pathogenic organisms, which may cause diseases. Other impacts related to occupational health and safety include environmental pollution, congestion and poor sanitation. Environmental pollutants may result from poor disposal of wastes; frequent overflows from latrines and improperly placed dumping sites. Accidental cuts, pricks and bruises are common among construction workers as a result of the use of machinery and hand tools.

6.3.5.2 Mitigation to occupational health and safety impacts

Below are mitigation measures to the occupational health and safety impacts.

a) Taking precautions: Every person at the proposed spring site should take precaution not to cause any effect on his/ her own health or to the health of any other person.
b) Border fencing: The site should be fenced to control access through a centralized gate.
c) Provision of personal protective equipment to workers: PPE include: masks, goggles, scarfs, footwear especially boots and overalls among other protective clothing as spelt out under section 101 (1) of OSHA, 2007. Protective clothing must be worn in all situations where the body and skin are potentially exposed to hazards such as chemicals, harmful dusts, sharp objects, burns and extreme temperature or are working in areas that present threatening experiences.

d) General employee welfare: Employee welfare issues include free medical attendance if injured on work. The contractor should also have provisions for sick leaves and offs for employees

6.4 Impacts during operation

During the operation, the following impacts may arise: change in flow regime, morphological features and water quality; change in ground water quality; water resource-use and risk of flooding and embracement failure.

6.4.1 Change in groundwater level and quality

6.4.1.1 Assessment Findings

Groundwater levels are liable to be impacted by the creation of an impoundment. Raised water levels upstream may result in a localized change to the water table. These changes to water levels may impact on groundwater upstream and downstream, resulting in water logging of soils or wells, and changes to catchments Infiltration. Since impoundment of a stream may lead to increased percolation of water to deeper levels, the percolating water if contaminated may lead to groundwater quality deterioration depending on soil type and condition.

6.4.1.2 Mitigation Measures

Impoundment may increase or decrease (dilution) the pollutant load of receiving waters while withdraws may indirectly lead to an increase of the pollutant loads affecting water quality. Measures will include;

i. Impounding the unnamed stream to promoting percolation of water to deeper levels
ii. Ensure that the water pan is constructed to standard design ensuring that there is no pan wall seepage thus minimizing losses while increasing retention time for percolation
iii. Regulate use of agro chemicals to maintain water quality in the reservoir
iv. Use only authorized agro-chemicals

6.4.2 Risk of dam failure

6.4.2.1 Assessment findings

Floods are a major cause of pan failure and therefore monitoring the dam during high water level conditions is critical. However, failure may also occur during normal conditions, and this failure tends to be the most dangerous because the resulting flood would be sudden. Indicators of a potential dam failure which include;

i. Settlement or cracking in the embankment.
ii. New sinkhole in reservoir area or on embankment
iii. Sudden or rapidly proceeding slides of the embankment slope
iv. Excessive erosion on the embankment, below the spillway, or at the abutments.
v. Excessive seepage or cloudy seepage through the abutments or embankments.
vi. Overtopping flow eroding the embankment slope
vii. Damage to pan or appurtenances that has resulted in uncontrolled water release

6.4.2.2 Mitigation measures

The proponent may consider the following measures;

i. Open principal spillway gate to lower the reservoir level as rapidly as possible to a non-erosive velocity. If the gate is damaged or blocked, pumping or siphoning will be employed instead
ii. Prevent vehicles and equipment from driving between the seepage exit points and the embankment to avoid potential loss from the collapse of an underground void.
iii. Construct sandbag or other types of ring dikes around the seepage exit areas to retain a pool of water, providing backpressure and reducing the erosive nature of the seepage.
iv. Place sandbags along the low areas of the top of the pan to reduce the likelihood of overtopping and to safely direct more water through the spillway.

6.4.3 Water quality management

6.4.3.1 Assessment

The rainwater runoff which will fill the reservoir flows over ground that is usually contaminated. The ground on catchment areas can have animal droppings, human excreta (especially from young children) and other rubbish on it that will pollute the water. While this water is suitable for livestock, small-scale irrigation and construction work it is NOT safe for drinking.

Reservoirs need to be maintained in a hygienic state to assure quality of the water. Silt, leaves, dead animals and other things can collect in the in the water and result in contamination. Spring water should be tested before and after heavy rains each year for bacteria. If water levels change frequently when it rains, the water may be very susceptible to contamination.

6.4.3.2 Mitigation

To ensure quality of water at the reservoir and particularly at the spring, the proponent needs to;

a) Carry out bacterial tests and other tests before and after heavy rains each year to detect presence of bacteria, giardia, cryptosporidium and other microorganisms, pH, turbidity, and conductivity to determine if surface-water contamination is a problem.
b) Put a wire screen on the pipe leading into the spring box to prevent unsafe material from entering pipes. This screen will be cleaned every now and again to ensure a steady flow of water.
c) Disinfect the spring water with chlorine

6.4.4 Conflicting water use demands

6.4.4.1 Assessment

During assessment there were no conflicting water demands within the proposed project area. Within the proposed project areas, many households are relying on protected natural spring water sources because of they are reliable and affordable. Most households at the proposed project site use water for domestic purposes and watering of animals.

6.4.4.2 Mitigation

To prevent problems associated with conflicting water demands, the following mitigation measures can be applied;

i. Ensure other water uses such as irrigation from the reservoir do not conflict with existing human, livestock, wildlife or aquatic water uses
ii. Ensure withdrawals are reliable from reservoir especially during dry seasons
iii. Encourage planting of crops/trees with lower water demands within the dam catchment

iv. Ensure effective community organization for equitable access to the proposed water pan

6.4.5 Contamination of drinking water

6.4.5.1 Assessment

During assessment, there were no reports/complaints of contamination of the water by the beneficiaries. Pathogenic contamination will be unlikely because the soil type and its thickness permit the required velocity of infiltration of the surface water to allow for natural filtration and biological action to remove pathogenic organisms before the water enters the aquifer feeding the spring. Waste water treatment plant and pit latrines will be located away from the proposed shallow well site. However, crop farming activities on the slopes surrounding the proposed spring will permit poorly drained storm water into the proposed well site exposing it to agro-chemical contamination.

6.4.5.2 Mitigation

To minimize the impacts associated with contamination of drinking water and dam water, the developer can consider applying the following measures:

i. Encourage integrated pest management within the pan catchment
ii. Embrace organic agriculture within the pan catchment
iii. Regularly conduct water quality analysis to ascertain quality of the water from the well
iv. Integrate on-site disinfection/chlorination of the well water
v. Fence the site to prevent intrusion by animals
vi. Avoid locating latrines and other waste water treatment systems in the immediate upstream of the proposed reservoir
vii. Ensure plants planted upstream that do not interfere with the water quality of the at the pan and the well
viii. Discourage washing activities within the proposed pan site
ix. Provide alternative facilities for washing and watering of animals.

6.4.6 Risk of flooding/back flow

6.4.6.1 Assessment

Flooding can occur during heavy rains which may in turn result in damage to the embankment and downstream of the water pan. Backflow waters may temporarily interrupt wit activities upstream of the reservoir. Back flow and flooding risk can occur due to poor spillway construction and poor design of storm water drainage.

6.4.6.2 Mitigation

Back flow and flooding risks can be mitigated by the following measures at the proposed site;

i. Keep the spillways clear of obstacles
ii. Appropriately manage storm water at the proposed site.
iii. Provide alternative facilities for washing and watering of animals

6.4.7 Drowning of livestock and children

6.4.7.1 Assessment findings

During the public consultation process respondents expressed fears in drowning incidents of children and livestock that they foresaw with the implementation of the project. However, the project design

includes a silt-trap and live fencing which will take care of these fears effectively. The proponent also plans to protect a water source for drinking water outside the main reservoir area.

6.4.7.2 Mitigation

The proponent should consider the following mitigation measures;

i. Undertake education and awareness of the local communities and making them aware of the hazards related to unrestricted entry into the dam reservoir.
ii. Fence the reservoir area, erect warning signs and control access of the dam while efforts should be put on teaching local people proper safety behavior and swimming.
iii. Construct water drinking points for the local communities as a strategy and a way for reducing increased access to the dam reservoir to get water which causes incidents.

6.4.8 Record keeping, documentation and environmental policy

In accordance with the EMCA (1999), records of environmental issues and operational licenses and permits need to be kept and availed to the Authority when necessary to prove compliance. These include waste disposal permits, accident registers and a list of all hazardous materials on site. In addition, inspection records; training records; waste disposal records; discharge-monitoring reports and local authority licenses amongst others are to be documented and kept safely. For efficient management of the proposed project; to facilitate further assessments and to comply with the law, it is recommended that the following records be kept always in addition to those mentioned above:

a) Training records in environmental issues and periodic review notes;
b) Records of violations and notification of authorities' correspondence in relation to the environment; and
c) Situational reports made to NEMA in accordance with Section 68(3) of the EMCA 1999.

6.5 Decommissioning phase

6.5.1 Assessment findings

The proposed reservoirs may be decommissioned when it no longer serves the purpose for which it was constructed. After significantly deterioration, the costs of repair may exceed the expected benefits, and dam removal may be a less expensive alternative.

6.5.2 Mitigation

i. Decommission the reservoir in phases (continued operation, partial reservoir removal, and full reservoir removal).
ii. Determine the reservoir sediment characteristics including volume, spatial distribution, particle-six distribution, unit weight, and chemical composition.
iii. Establish an inventory of the existing infrastructure around the reservoir, along the downstream river channel, influenced by the reservoir.

7 ANALYSIS OF PROPOSED PROJECT ALTERNATIVES

7.1 Introduction

The purpose of this section is to examine feasible alternatives to the proposed project. The benefits of the proposed project will be considered against any potential environmental cost. The general principle involved in identifying alternative option(s) to a proposed development is to ensure that the option chosen results in optimal social, environmental and capital benefits not only for the developer, but also for the environment and stakeholders in the area. This section is critical in consideration of an ideal or near-ideal development with minimal environmental disturbance. The following feasible land-use options will be compared in terms of cost and benefit criteria: environmental impacts, social acceptability, economics (including productivity of land-use) and design feasibility.

7.2 "No-action" alternative

The selection of the "no-action" alternative would mean the discontinuation of the proposed project. Thus, the site is retained in its existing form. If this alternative is selected, the site is unlikely to undergo any major changes from its present condition and the vegetation present at the site will not be affected.

7.3 Relocation Alternative

This option would mean transfer of the proposed development to another site. If this option is selected the Proponent is required to look for an alternative site either within or outside the zone.

7.4 Alternative land-uses

The option allows the developer to explore other alternative land-uses for the site other than the proposed project. This option requires application for change or extension of use to allow for the alternative development.

7.5 The proposed development as described in the EIA report

The impacts and mitigation measures for this alternative are discussed in detail throughout this report. The positive impacts have been identified. The project Proponent has already made financial commitments in designing and planning for the proposed project. These include application fees to the county government, public health officers and physical planners; and professional fees to the project managers, architects, quantity surveyors, land surveyors, EIA lead experts among others.The proposed design has been approved by the public health office and the physical planning officer. The proposed project will employ modern construction technologies that are approved by NCA as per the Building Code, 1953. The Merits of this alternative are as follows:

a) The property (land) value will appreciate and the investment made in the project will be productive from the optimal economic and spatial land-use.
b) Visual and aesthetic amenities will be improved.
c) The community will have a potential source of income through the supply of water throughout the season for small scale irrigation from employment opportunities to be created by the proposed project.
d) The inhabitants will access irrigation water for sustainable farming.

8 ENVIRONMENTAL MANAGEMENT AND MONITORING

8.1 Environmental management

This section is intended to provide a concise structure of actions with specific priority levels for the management of the environment in all phases of the proposed project. Environmental management is best achieved by preparation and implementation of an EMP. The plan ensures that environmental impacts are identified and mitigated by outlining corresponding management strategies that need to be implemented to mitigate potential adverse environmental impacts and assigns responsibility for the implementation of the mitigation measures. All costs are estimates and may change in time and space. As project commencement and scheduling plans are developed and changed, components of the EMP might require amending. The EMP is generally prepared to ensure that the components of proposed project are operated in accordance with the design, standards and regulations. If the proposed development is implemented without any environmental management options the total project impact will be on the appreciably adverse side. However, if the environmental management strategies discussed in the EMP is fully implemented, the adverse impact of the project would be reduced and there will be an overall improvement in the environment.

8.2 Environmental monitoring and audits and record keeping

Environmental monitoring and audits are conducted to establish if project implementation has complied with established environmental management standards. Environmental audits (EAs) are conducted annually beginning twelve months from the date of commissioning of the project to ensure that identified potential negative impacts are mitigated. EA reports will be submitted to the Authorityin accordance with Section 68 (3) of the EMCA, 1999(Cap. 387), amended 2015. Environmental monitoring will best be achieved by keeping proper records of the progress of the facility. Some of the records to be kept include:

a) List of materials according to approved classification schedule;
b) Emergency management procedures;
c) Staff training records in environmental issues and periodic review notes; and
d) Records of violations and notification of authorities' correspondence in relation to the environment.

Table 8.1: Proposed EMP for the construction phase of the proposed development

Area of concern	Environmental impact	Standards & guidelines	Management and mitigation	Monitoring requirements	Responsibilities	Mitigation cost (Kshs.)
Biodiversity conservation	Loss of flora and fauna Increased soil erosion Destruction of habitats	EMCA, 1999	• Ensure proper demarcation of the proposed project area • If native fauna species are discovered contact Wildlife department for further instructions • Any unexpected finds of potential archaeological significance shall be reported to the Kenya National Museum, and construction works will be ceased until permission is granted to proceed	Reports of loss flora/fauna	Proponent/Contractor	20,000
			• Re-establishing vegetation of disturbed areas through implementation of a well-designed landscaping programme. • Strictly control storage of construction materials over designated areas • Ensure clearing of vegetation is restricted to only marked area	Number of trees cleared	Proponent/Contractor/Community	50,000
Soil conservation	Soil erosion Siltation of water bodies Loss of fertile soils	EMCA, 1999 Water Act, 2002	• Avoid unnecessary clearing of the vegetation • Limit use of heavy machinery to designated areas • Rehabilitate heavily disturbed areas • Install silt fences, sandbags and/or hay bales where required down gradient of disturbed areas, base of embankments, existing drainage lines, earthworks and stockpiles • Restrict heavy plant and vehicle movements to hard surfaces after significant rain events • Conduct daily inspection of erosion & sedimentation control measures including after rainfall • Create contour drains during construction	Siltation trends Trends in land tiling	Contractor/Community	30,000

Area of concern	Environmental impact	Standards & guidelines	Management and mitigation	Monitoring requirements	Responsibilities	Mitigation cost (Kshs.)
			• Terracing of the sloppy areas of the land and plating of nappier grass along the canals.	Land fertility	Community	-
			• Plant indigenous trees 2-3m apart around the dam to stabilize the sides/banks • Create a buffer between the water front and occupied areas of human settlement and agricultural activities.	Land fertility	Proponent	10,000
Drowning of livestock and children	Loss of human lives Loss of livestock	Public health Act OSHA, 2007	• Undertake education and awareness of the local communities and making them aware of the hazards related to unrestricted entry into the pan reservoir. • Fence the reservoir area, erect warning signs and control access of the pan while efforts should be put on teaching local people proper safety behavior and swimming. • Construct water drinking points for the local communities as a strategy and a way for reducing increased access to the pan reservoir to get water which causes incidents.	Reports of drowning	Management committee	30,000
Hazardous waste management	Contamination of water and soils due to spills Destruction of aquatic habitats	EMCA, 1999 Public Health Act Water Act, 2002	• Ensure all machinery and equipment is regularly maintained • No vehicle maintenance, and non-operational/routine plant or equipment maintenance, will be conducted on-site • Dispose any used oil at a designated place in accordance with the law • Keep an inventory of oil spills during construction period • Monitor water sources in close proximity for oil spills once every month	Frequency of oil spills Water quality records	Contractor	20,000
Land dereliction	Barrow pits Unstable grounds	EMCA, 1999 Public	• Rehabilitate the affected areas through reforestation • Restrict movement of vehicles and equipment	Number of barrow pits Stockpile of	Contractor/ Community	50,000

Area of concern	Environmental impact	Standards & guidelines	Management and mitigation	Monitoring requirements	Responsibilities	Mitigation cost (Kshs.)
	Soil erosion Loss of flora Loss of fauna	Health Act	to designated areas • Restrict clearance of vegetation to critical areas • Remove all stockpiles and overburden • Stabilize all slopes and unstable areas. • Maintain drainage at the dam site • Backfilling and leveling of the borrow pits to prevent water percolation	excavated materials		
Waste Management	Creation of habitats for rodents Contamination of water Degradation of the environment	EMCA, 1999 Water Act, 2002 Public health Act (EMCA) Waste management regulations, 2006	• Some of the rubble should be used for compaction in the construction of the embankment • Practice reduce, reuse and recycle waste management techniques • Put in place an efficient waste management system that will prevent the accumulation of wastes to uncontrolled levels • Regularly collect wastes to prevent accumulation	Quantity of waste generation Accumulation of rubble	Contractor/ Community	20,000
			• Discourage open air incineration of solid wastes; • Designate waste collection and disposal sites	Waste management practices	Management Committee	10,000
Human health and diseases	Vector borne diseases Creation of habitat for	EMCA, 1999 Water Act, 2002	• Ensures continuous flows via the spill way to reduce the likelihood of creation of habitats for diseases causing organisms such as bilharzia	Flow rates from the pan	Contractor Management committee	30,000

Area of concern	Environmental impact	Standards & guidelines	Management and mitigation	Monitoring requirements	Responsibilities	Mitigation cost (Kshs.)
	diseases causing fauna Incidence of social issues such as spread of STIs	Public health Act	• Monitor the presence of disease vectors • Encourage people in the vicinity of the proposed site to use treated mosquito nets • Sensitize staff and community on the dangers of STIs such as HIV/AIDs • Plant *Phytolacadecocandra* to help destroy the snails that serve as hosts of systomiasis Encourage eco-friendly methods of vector control such as practicing fishing to control mosquitoes	No. and prevalence of disease vectors within the project site	Management committee	20,000
Changes in Hydrology	Changes in stream morphology Changes in water table levels around the reservoir	EMCA, 1999 Water Act, 2002	• Ensure that the design has adequate design provisions to allow flow downstream even in times of dry months. • Apply standard dam operational rules • Observe water right permit regulations and requirements for the sake of downstream users • Impounding the unnamed stream to promoting percolation of water to deeper levels • Undertake hydrological assessment of the catchments	Complains from downstream users	Management committee	10,000
			• Ensure that the pan is constructed to standard design ensuring that there is no embankment seepage to minimize losses while increase retention time for percolation	Decreased stream water levels during dry season	Contractor	30,000
Water quality management	Changes in water quality Loss of aquatic life Invasion of alien aquatic weeds	EMCA, 1999 Public Health Act Water Act, 2002	• Avoid discharge of any waste effluent into the dam	Waste discharges	Contractor/Management committee	20,000
			• Train farmers on Pesticide/Fertilizer Application • Prepare an Integrated Pest Management Plan	Invasion of alien weeds Nutrient Load	Management committee	50,000

Area of concern	Environmental impact	Standards & guidelines	Management and mitigation	Monitoring requirements	Responsibilities	Mitigation cost (Kshs.)
			• Regulate use of agro chemicals to maintain water quality in the reservoir • Use only authorized agro-chemicals • Encourage organic agriculture within the proposed dam area • Conduct awareness on invasive aliens aquatic weeds			
			• Discourage adverse land use activities such as waste disposal sites and intensive agricultural practices around the reservoir • Ensure adequate facilities are provided for staff such as sanitation facilities	Trends in water quality	Management	10,000
Geologic hazards/overflow	Risk of dam failure Risk of flooding Risk of loss of lives and property	EMCA, 1999 Public Health Act	• Open principal spillway gate to lower the reservoir level as rapidly as possible to a non-erosive velocity. • Prevent vehicles and equipment from driving between the seepage exit points and the embankment to avoid potential loss from the collapse of an underground void. • Construct sandbag or other types of ring dikes around the seepage exit areas to retain a pool of water, providing backpressure and reducing the erosive nature of the seepage. • Place sandbags along the low areas of the top of the pan to reduce the likelihood of overtopping and to safely direct more water through the spillway	Cracks in the embankment. Incidence of new sinkhole Excessive erosion on the embankment Incidences of seepage in the embankment	Contractor/ Management committee	50,000
			• Ensure overflow spill is of adequate capacity	Reliability of the overflow spill	Management committee	10,000
Economic aspects	Skill transfer to local population	EMCA, 1999 Public	• Local people should be given priority for employment particularly as casual laborers	No. of local laborers on-site	Proponent/ Contractor	20,000

Area of concern	Environmental impact	Standards & guidelines	Management and mitigation	Monitoring requirements	Responsibilities	Mitigation cost (Kshs.)
	Changes in economic activities	Health Act	• Promote formation of small holder schemes to be run by small scale farmers within the community • Ensure equitable access and utilization of the water resource for sustainable development	No. of secondary economic activities	Management committee	10,000
Water resource use management	Conflicting water use demands Excessive water abstractions Loss of biodiversity	EMCA, 1999 Water Act, 2002	• Ensure other water uses such as irrigation from the reservoir do not conflict with existing human, livestock, wildlife or aquatic water uses • Ensure withdrawals are reliable from reservoir especially during dry seasons • Ensure effective community organization for equitable access to the proposed water pan	Complains of conflicting water use	Proponent/ Management committee	20,000
			• Encourage planting of crops/trees with lower water demands within the dam catchment • Train local farmers on how to operate and maintain water intake points and canals to ensure that there is no blockages or flooding.	Type of trees planted around the dam	Management Committee	10,000
Occupational safety and health	Occupational hazards & accidents Occupational sickness/illness	OSHA, 2007 Public health Act EMCA, 1999	• Every person at the proposed pan site should take precaution not to cause any effect on his/ her own health or to the health of any other person. • The site should be fenced to control access through a centralized gate. • Provision of personal protective equipment to workers. • Provision of first aid facilities and services. • Employee welfare issues include free medical attendance if injured on work. • Provisions for sick leaves and offs for employees	No. of accidents reported at the site PPE for workers Availability of first Aid Kits	Contractor	40,000

Area of concern	Environmental impact	Standards & guidelines	Management and mitigation	Monitoring requirements	Responsibilities	Mitigation cost (Kshs.)
Environmental policy	Lack of commitment to environmental concerns	EMCA, 1999	• Develop an environmental policy as a guiding principle for corporate environmental management • Encompass an elaborate environment plan as a framework for monitoring mitigation	Routine adherence	Proponent/ Management Committee	10,000

Table 8.2: Proposed EMP for the operational phase of the proposed water pan

Area of Concern	Impacts on the environment	Guidelines/standards	Mitigation Measures	Monitoring indicators	Responsible Party	Mitigation Cost
Soil erosion	Loss of fertile soils Increased sedimentation in the outlets from the stream	EMCA, 1999	• Design and layout of furrows upstream of the proposed water point site • Avoid tapping at unsuitable slope gradients • Minimize tillage, practice contour cropping, terracing and other methods of conserving soil moisture around the water point • Maintain natural vegetation within a radius of 50 meters around the water point	Decline in agricultural productivity around the water pan Blocked drainage systems with soils	Community/ Management committee	10,000
Water resource Management	Conflicting water demands	EMCA, 1999 Public Health Act Water, Act	• Locate the water point where water supplies will not conflict with existing human, livestock, wildlife or aquatic water uses • Ensure withdrawals are reliable from groundwater resources especially during dry	Water use conflicts	Proponent/ Management committee	10,000

			seasons • Encourage crops with lower water demands around the water point • Ensure effective community organization for equitable access to the proposed water point			
Contamination of the catchment area of the spring	Reduction in water quality Water borne diseases Loss of aquatic life	EMCA, 1999 Water Act Public Health, Act Wetland regulations OSHA,2007	• Encourage integrated pest management within the water point catchment • Embrace organic agriculture around the water point • Regularly conduct water quality analysis to ascertain quality of the water from the water point • Integrate on-site disinfection/chlorination of the water point • Fence the site to prevent intrusion by animals • Avoid locating latrines and other waste water treatment systems in the immediate upstream of the water point	Trends in water-borne diseases Water quality records Agro-chemical use in neighboring farms	Community/ Management committee	10,000

			• Ensure plants planted upstream of the spring do not interfere with the water quality of the water point • Discourage washing activities within the proposed water point site • Provide alternative facilities for washing and watering of animals			
Risk of flooding/backflows	Pollution of water sources Loss of access to quality water for domestic purposes	EMCA, 1999 Water, Act	• Avoid tapping at sites that may be prone to flooding/back flows • Design the spring to prevent backflow of water from outlets • Keep the outlets clear of obstacles • Appropriately manage storm water at the proposed site. • Provide alternative facilities for washing and watering of animals.	Stagnant water in outlets from the proposed spring Demand on alternatives sources of water during rainy season	Contractor/ Management committee	10,000
Construction waste pollution	Creation of habitats for pathogens and rodents\	EMCA, 1999 Solid Waste Regulations, 2006	• Secure a centralized solid waste collection point away from the water point;	Sprawling solid wastes	Contractor/Management committee	5,000

	Blockage of drainage canals from the spring		• Practice source separation of wastes into biodegradable and non-biodegradable • Encourage re-use, recycling and waste reduction • Any open air incineration of solid wastes must be done in an area far away from any combustible materials; • Avoid accumulation of solid wastes to uncontrolled levels • Ensure the collection and disposal of the wastes is done regularly and appropriately.			
Land use and access to the spring	Land ownership conflicts between potential beneficiaries and the landowner Lack of access clear access road to	EMCA, 1999 Land, Act	• Clearly demarcate and improve the access road to the proposed water point site • Facilitate agreement between the potential beneficiaries, management committee and the land owner on land ownership • Prevent intensive land	Conflict between beneficiaries and the landowner Complains of access road to the proposed water pan from	Community/ Management committee	5,000

	the proposed spring site		use activities within radius of 50 meters by the neighbours to the proposed water point site	potential beneficiaries		
Environmental policy	Lack of commitment to environmental concerns	EMCA, 1999	• Develop an environmental policy as a guiding principle for corporate environmental management • Encompass an elaborate environment plan as a framework for monitoring mitigation	Routine adherence	Proponent/ Management committee	5,000

Table 8.3: Proposed EMP for the decommissioning phase of the proposed development

Area of Concern	Impacts on the environment	Mitigation Measures	Monitoring indicators	Responsible Party	Mitigation Cost
Soil conservation	Siltation of rivers Loss of fertile soils Degradation of catchments	• Limit use of heavy machinery to designated areas • Rehabilitate heavily disturbed areas • Install silt fences, sandbags and/or hay bales where required down gradient of disturbed areas, base of embankments, existing drainage lines, earthworks and stockpiles • Plant indigenous trees 2-3m apart within the proposed site • Conduct daily inspection of erosion & sedimentation control measures including after rainfall	Complaints of siltation downstream Land dereliction at the proposed site	Management committee	30,000
Biodiversity conservation	Loss flora & fauna Destruction of habitats	• Re-establishing vegetation of disturbed areas through implementation of a well-designed landscaping programme. • Engage in fish harvesting before decommissioning works • Take stock of endangered flora/fauna and report to the relevant authorities	No. of flora/fauna affected	Contractor/ Community/ Management committee	20,000
Sediment management	Siltation of downstream	• Decommission the reservoir in phases (continued operation, partial reservoir removal, and full reservoir removal). • Determine the reservoir sediment characteristics including volume, spatial distribution, particle-six distribution, unit weight, and chemical composition. • Establish an inventory of the existing infrastructure around the reservoir, along the downstream river channel, influenced by the reservoir	Sediment loads	Management committee/ Community	50,000

9 RECOMMENDATIONS AND CONCLUSION

9.1 Recommendations

This study recommends that the proposed project be allowed to proceed on strict condition that the environmental management plan is implemented and follow-up is made to ensure compliance as may be directed by NEMA.The management is to comprehensively implement the recommendations below in order to improve on their level of compliance.

- Strict adherence to legal requirements in respect to use of personal health and safety equipment will be required in order to avoid potential negative impact of the works to workers and the neighboring community.
- Ensure record keeping and documentation are appropriately carried out to assist in building of self-auditing capacity.
- The development should be undertaken since it will improve the standards of reservoir facilities in the area.
- Environmental auditing of the proposed project will also be carried out annually to measure environmental performance/compliance.

9.2 Conclusion

The primary objective of the proposed project is to enhance access to a sustainable water supply for small scale irrigation and fishing activities. The adverse impacts anticipated by this study can be effectively managed by the proposed EMP which includes mitigation measures already thought out in the design and feasibility study phase. Positive impacts of the proposed reservoir rehabilitation include poverty reduction, food security, and rural development, among others.

If the suggested mitigation measures and the above recommendations are put in place and the proposed EMP is followed, the proposed project will not adversely impact the environment. These mitigations will not only be of benefit to the proposed development, but will also assist other stakeholders in understanding and managing the environment.

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APPENDICES

Copy ofTitle Deed/Land ownership documents/MOU

Copy ofarchitectural and structural design drawings

EIA public participation comment sheets

Copy ofcurrent NEMA EIA/EA expert licenses