THE REPUBLIC OF KENYA

AFRICAN DEVELOPMENT BANK GROUP

ATHI WATER
Transforming Life. Inspiring Progress

Financial Cooperation between the Government of Kenya and African Development Bank (AfDB)

ATHI WATER SERVICES BOARD (AWSB)

MULTI TOWNS SUSTAINABLE WATER AND WASTE WATER MANAGEMENT PROGRAM

Environmental and Social Impact Assessment Study

NEMA REF: PR/5/2/15000

Limuru Sewerage Project

FCL
Frame Consultants Ltd
P.O.BOX 58624 - 00200
Nairobi, Kenya

JULY 2016

"DOCUMENT CONTROL"

MULTI TOWNS SUSTAINABLE WATER AND WASTE WATER MANAGEMENT PROGRAM

LIMURU SEWERAGE PROJECT

EMPLOYER:

Athi Water Services Board
(AWSB)

CONSULTANT

Frame Consultants Ltd

DOCUMENT TITLE

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT STUDY REPORT

VERSION 02

RECORDS FOR REVISION

VER.:	DATE:	DESCRIPTION/PURPOSE OF ISSUE:	PREPARED BY:	CHECKED BY:	APPROVED BY:
01	06/23/2016	**DRAFT ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT STUDY REPORT**	G. Sakwa	Eng Francis Kimani	Eng Emily Kilongi
02	06/23/2016	**2ND DRAFT ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT STUDY REPORT**	G. Sakwa	Eng Francis Kimani	Eng Emily Kilongi

FACT SHEET

Programme Name	Kenya Multi Towns Sustainable Water and Waste Water Management Program
project Name	Limuru Sewerage Project
Lead Implementing Agency	Athi Water Services Board (AWSB)
Funding Agencies	Government of Kenya through a loan from African Development Bank (AfDB)
Consulting Engineers	Frame Consulting Limited
Report	Environmental and Social Impact Assessment Study Report
Project Components	• Secondary Sewers, diameter varying in sizes from 200mm to 300mm and Trunk Sewers, diameter varying in size from 450mm to 600mm approximate length 31km. • Rehabilitation, augmentation and expansion of the existing waste water treatment plant from plant capacity of 500m3/day to 5,900m3/d capacity. • The proposed technology is oxidation ditches same technology as existing Sewerage Treatment Works.
Project Beneficiaries	• The population to be served is approximated to be 35,438 by the ultimate design period of ther year 20138
Project Cost	• Kshs 625,800,000
Target areas	• Limuru Town and satellite centres of Karanjee, Kwambira, Bibirioni
Lead Expert	Godwin Sakwa Lidahuli Reg.Nr. 2492

NEMA Report Submission Details

Completed By:

Signed ……..Date…….

Godwin Sakwa Lidahuli
LEAD EXPERT NEMA REG NO. 2492

PROPONENT

Signed ……..Date…….

Name……..
ATHI WATER SERVICES BOARD (AWSB)
HEAD PLANNING AND ENGINEERING SERVICES DEPARTMENT

LIST OF ACRONYMS

AfDB	African Development Bank
AWSB	Athi Water Services Board
BOD	Biological Oxygen Demand
CDF	Community Development Fund
CG	County Government
GHG	Green House Gases
ECD	Early Childhood Development
EA	Environmental Assessment
EHS	Environment Health and Safety
HESP	Health and Safety Plan
ESIA	Environmental and Social Impact Assessment
ESMMP	Environment and Social Management & Monitoring Plan
EMSF	Environmental and Social Management Framework
EMCA	Environmental Management and Coordination Act
ESA	Environmental and Social Assessment
EA	Environmental Assessment
EHS	Environmental, Health and Safety Guidelines
ILRI	International Livestock Research Institute
IFC	International Finance Cooperation
ILO	International Labour Organization
IBRD	International Bank for Reconstruction Development
IDA	International Development Agencies
KFS	Kenya Forest Service
KfW	KfWEntwicklungs bank (KfW Development Bank)
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Services
HASP	Health and Safety Plan
LIWASCO	Limuru Water and Sewerage Company
MTP	Medium Term Plan
MDG	Millennium Development Goal
MAS	Modified Activated Sludge
MSF	Multi-stakeholder Forum
NEC	National Environment Council
NEP	National Environment Policy
NEMA	National Environment Management Authority
OS	Operation Safeguards
OP	Operations Policy
PAD	Project Appraisal Document
PCR	Physical Cultural Resources
PPP	Private Public Participation
RAP	Resettlement Action Plan
SDG	Sustainable Development Goals
SUP	Socially Uplifting Project
TPT	Town Planning Team
WB	World Bank
WRMA	Water Resources Management Authority
WWTP	Waste Water Treatment Plant

TABLE OF CONTENTS

EXECUTIVE SUMMARY

List of Annexes

E. EXECUTIVE SUMMARY

E-1 Project

This report is an Environmental and Social Impact Assessment (ESIA) Study Report for the proposed Limuru Sewerage Project for Limuru Town planned to be financed under the Kenya Multi Towns Sustainable Water and Waste Water Management Program of the African Development Bank (AfDB)

Limuru town has a sewerage system which serves Limuru Township. The Wastewater Treatment Works (WWTW) has a design capacity of 550 m³/day at Dry Weather Flow. The WWTW was designed in 1974 and was to be implemented in two phases. Phase I was to serve a population of 4,500 persons in 1985.

The project involves extension Trunk Sewers, diameter varying in size from 450mm to 600mm approximate length 31km to Karanjee, Limuru Town and Kwa Mbira and construction of Secondary Sewers, diameter varying in sizes from 200mm to 300mm within the same areas. The Project will also involve rehabilitation, augmentation and expansion of the existing waste water treatment plant from plant capacity of 500m3/day to 5,900m3/d capacity. The proposed technology is the **oxidation ditches** which is the technology which the current waste water treatment works use.

The preliminary design report[1] prepared for the project indicates the population projection, water demand and sewerage flow for Limuru area as summarized in **Table E-1** below

Table E-1: Population, Water Demand and Sewerage Flow Projection

Parameter	Year 2016	Year 2018	Year 2028	Year 2038
Population Projection	18,721	20,032	27,186	35,486
Water Demand (m^3/day)	5,888 m^3/day	6,190 m^3/day	7,705 m^3/day	9,492 m^3/day
Sewerage flows	3,071 m^3/day	3,309 m^3/day	4,502 m^3/day	5,912 m^3/day

The preliminary design report analyzed three options for location of the waste water treatment plant and five options for sewerage treatment technology as presented in **Table E-2** below

Table E-2: Sewerage Treatment Site and Technologies Analyzed

Site Analysis	Technology Options considered
i. Gravitate the sewage Dandora Estate Sewage Treatment Works (Nairobi) ii. Construction of a Sewage Treatment Works at Tigoni (7km downstream) iii. Use of the existing site.	i. Waste Stabilisation Ponds, ii. Aerated Lagoons, iii. Oxidation Ditches, iv. Percolating/Trickling Filters, v. Combined Anaerobic Ponds-Trickling Filters Process

[1] Preliminary Design report prepared by Frame Consultants in June 2016

The cost for implementation of the Sewerage System for Limuru comprising of rehabilitation of existing sewers, rehabilitation of existing 550m3/d Sewage Treatment Works and Construction of 31km sewers and 5,150m3/d Oxidation Ditches sewage treatment works is estimated to be KShs. 625,800,000.00. The project once commissioned will benefit a population of **35,486 persons** within the Limuru town and satellite centers of Karanjee, Kwambira, Kamirithu and Bibirioni

E-2 Land Requirement / Ownership

The project is divided in two components as illustrated in **table E-3** below. The purpose of categorizing the project was to have a clear analysis of the environment and social impacts and also to clearly analyze land requirement for the project as described below.

Table E-3: Project Components

Project Component	Description	Land Requirement
Component 1	Sewer Pipelines and associated works	• No land requirement needed sewer Lines to be constructed within road reserves • RAP prepared to address compensation requirements for project impacts encroaching into road reserve
Component 2	Waste Water Treatment Plant works	• No Land extra land required, the augmentation works and expansion works to be restricted within existing Kiambu County Government land for the WWTW

E-3 Legal and Regulatory Instruments

The Report preparation was guided by relevant policies, legislation and institutional frameworks that guide preparation of ESIA at both National and International level. These instruments include; the National Environment Policy (NEP), HIV and AIDs Policy 2009, HIV Prevention and Control Act of 2006, Gender Policy 2011

Water Act 2002, Environmental Management and Coordination Act (EMCA) 1999, County Government Act no 17 of 2012, Physical Planning Act 1996 (286), Occupational Health and Safety Act (OSHA 2007), Public Health Act (Cap.242) and the Eviction Way-leave and Rehabilitation Bill (2014).

The assessment also made reference to African Development Banks (AfDB) Operational Safeguards (OS) Policies. These Policies include; OS 1: Environmental and Social Assessment; OS 2: Involuntary Resettlement, Land Acquisition, Population Displacement and Compensation; OS 3: Biodiversity and Ecosystem Services; OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency and OS 5: Labour Conditions, Health and Safety.

E-3 Highlights of Stakeholder Consultations

The assessment involved consultations with relevant stakeholders in Limuru town. The aim of

stakeholder consultations was to give a platform for information sharing and opinion gathering in relation to the proposed project, consultations were done in form of public meetings and key informant interviews. The issues were than analyzed and presented to design team for finalization of Project designs and planning on how best to implement the Project. The main meetings were held within the month of September 2015 and June 2016 in Limuru Town, attendance of the meetings was from diverse sectors of the society. In Summary, issues discussed is presented in **Box E-1** below

Box E-1: Summary of Issues discussed in Public Consultations

- Project implementation time lines
- Management of odour menace from the plant
- Sewer pipeline easement corridor
- Resettlement issues
- Compensation for loss of assets and sources of livelihood
- Factories in the area and whether they will connect to the sewer
- Modalities of getting sewerage connections
- Water and sewerage tariff whether the project will trigger tariff increase

Details of stakeholder consultations are presented in Chapter 6 of the assessment.

E4 Project Impacts

The Project impacts during the assessment were generated based on the analysis of the proposed project activities in relation to the Project area environment. The impacts arising during each of the phases of the proposed development namely; construction, operation and decommissioning, were categorized into:

- Impacts on biophysical environment;
- Health and safety impacts; and
- Social-economic impacts

Section E4.1 to E4.4 below provides a summary of the Project impacts both positive and negative discussed in this Report.

E4.1 Project Positive Impacts during Construction

The Project is a Socially Uplifting Project (SUP) and it's envisaged to have more positive impacts after completion of the civil works and commissioning. A summary of anticipated positive impacts of the Project include:

- Employment opportunities during construction
- Creation of a market for construction materials
- Injection of money into the local economy
- Creation of wealth to residents through direct and indirect business

E4.2 Positive Impacts during Operation

The Project shall result to both direct and indirect benefits to the residents of Limuru Town, these benefits are summarized below:

- Improved Sanitation of Limuru town
- Improve Health and Hygiene of Limuru residents
- Reduced pollution of natural river systems
- Creation of job opportunities

- Improved quality of water in rivers within the Project area. (Ithanji, RiuRwaka river and Tigoni dam)

E4.3 Negative Impacts and Mitigation Measures during Project Construction Period

The Project Construction Phase shall involve the following activities; delivery of construction of pipes and associated fittings to the Project site, manual excavation of trenches, temporary stockpiling of soils, sub-soils and rock along the trenches, importing material for bedding of concrete joints of the water lines and sewer lines (e.g. sand, cement, and concrete) and delivering pipeline sections, culverts and manhole covers to site.

The activities discussed above have the potential of triggering negative environment and social impacts during Project Construction Phase, **table E-3** below provides a summary of potential negative impact and proposed mitigation measure.

Table E-3: Negative Impacts and proposed Mitigation measure during Construction

Impact	Summary of Mitigations
Project impact to private property and sources of livelihood along the roads and river riparian	Prepare a Resettlement Action Plan (RAP) for purposes of compensation of likely assets and sources of livelihood for Project affected persons along the sewer lines.
Vegetation clearing, soil erosion and siltation	• Contain excavated soils so that they will not find their way into nearby water sources; • Spilled cement or concrete should be collected and disposed away from natural water ways or storm water drainage; • Sensitise workers and enable them to properly handle concrete spillages or waste cement; • Re-vegetation of exposed areas around the site should be carried out rapidly in order to mitigate against erosion of soil through surface water runoff and wind erosion.
Air quality pollution caused by emissions from construction plant and equipment which include dust and gaseous emissions.	• Maintain construction equipment at high operational conditions such as to control emissions into the air. • Earth moving be done under dump conditions as much as possible to prevent emission of dust into the air, • It will be necessary to notify the immediate neighbourhoods on the potential odors during the excavations. The period should, however, be kept as short as possible (odor generation may not be fully eliminated during the period)
Noise and excessive vibration from construction equipments and vehicles	• Conduct periodic noise measuring and monitoring to determine levels and extent of harmful noise; • Provide PPE (hearing protection) to persons operating within or visit identified high noise areas; • In order to meet noise level requirements, the equipments should be equipped with standard noise attenuation features. Machines that exceed acceptable noise limits should be equipped with silencers or lagging materials or specially designed acoustic enclosures; • Inform local residents when construction activities are likely to generate excessive noise in order to minimize disruption to local residents;
Water quality pollution from construction	• Isolate solid wastes disrupted from the works during excavations for safe disposal. The wastes should be collected and disposed in approved sites.

Impact	Summary of Mitigations
activities which include solid and effluents waste	• Earth moving and excavations for the construction are carried out considering safety of the river and surface drainage. Control siltation of rivers and other surface drains • Ensure spilt oil does not discharge into water sources Provide oil spill containment including concrete platform for servicing of construction equipment and holding of scrap oil drums.
Interference with drainage and hydrology within Project site	• Excavated channels to follow natural water course to avoid interference with surface drains; • Whenever necessary, drains along the construction line are directed towards existing drainage systems to cater for storm water during the rains. However, construction should be carried out during a dry season and should take the shortest period possible; • Utilise excavated soil to level excavated ground where necessary and cover the water and sewer lines that will have been laid in the ground.
Interruption of existing infrastructure such as roads, waterlines and power lines	• Formal request for permission to cross, break in and lay the pipelines should be sought from affected property owners; and relevant utilities • A work plan with clear responsibilities for each party should be developed to ensure smooth execution of the construction.
Solid waste generation from construction activities	• A site waste management plan should be prepared by the Contractor prior to commencement of construction works. This should include designation of appropriate waste storage areas, collection and removal schedule and identification of approved disposal site; • Ensure that the solid waste collection, segregation, and disposal system is functioning properly at all times during the construction phase; • Recycle and re-use wastes where possible such as scraps metal.
Occupational health and safety risks associated with the Project	• Establish a Health and Safety Plan (HASP) for civil works areas ensuring the working hours are controlled and that employees are not allowed to extend the working hours beyond an acceptable limit for purposes of gaining extra pay; • Provide workers with gloves, ear gears, sturdy rubber boots and overalls to protect their skin from the effects of cement; • Provide workers training on safety procedures and emergency response such as fire and sewer pipe bursts;
Spread of communicable diseases and HIV/AIDS infection	• Develop appropriate training and awareness materials for Information, Education and • Develop an intervention strategy compatible with the construction programme to address success of the HIV/AIDS prevention and provide peer educators for sustainability in collaboration with other stakeholders; and • Integrate monitoring of HIV/AIDS preventive activities as part of the construction supervision. Basic knowledge, attitude and practices are among the parameters to be monitored, and particularly on provision of condoms, status testing and use of ARVs

E4.4 Project Negative Impacts and proposed mitigation measure during Operation Phase

The Project once commissioned has the potential of triggering negative impacts associated with operation and maintenance as summarized in **table E-4** below.

Table E-4: Negative Impacts and Mitigation measure during Project Operation Sewer Lines and Waste Water Treatment Works

SEWER LINES

Issue	Summary of Mitigation
Risk of encroachment and construction of structures on the sewer wayleaves	• Mapping and installation of beacons to which illustrate the width of the pipeline reserve • Regular patrol of the pipeline corridor for encroachment. • Prosecution of encroachers as required by County By Laws on way leaves and road reserves maintenance. • Conduct public sensitization programs on importance not interfere with way leaves and public reserve land
Risk of farming using raw sewerage, this has potential of vegetation and soil contamination.	• Conduct public sensitization programs on importance not interfere with the sewer pipeline and dangers associated with farming using raw sewerage. • Constant inspection by LIWASCO officials to indentify and repair the punctures pipelines • With the help of police, arrest and prosecute persons farming using raw sewerage using county government by laws.
Risk of illegal connection to the sewer pipeline	• Conduct public sensitization programs on importance not interfere with the sewer pipeline and the need to seek official water connection from LIWASCO • Constant inspection by LIWASCO officials to indentify and repair the punctures pipelines • Prosecute persons illegally connecting to the sewer lines as provided by County Government By laws
Risk of Sewer blockage and overflows to the environment	• Awareness rising among community members not to dump solids in manholes. • Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups • Development of an inventory of system components, with information including age, construction materials, and drainage areas served including elevations. • Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize entry of garbage and silt into the system • Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulphide generation
Risk of Vandalism of the infrastructure (manhole covers and man hole step irons)	• This is common when the manhole covers are made using steel and concrete, also step iron bars in the manholes, the steel is usually stolen by steel scavengers. • Use alternative material for manhole covers and step iron
Land and Soil Contamination	• LIWASCO to attend to burst sewer pipes promptly to prevent excessive soil contamination. • Provide high risk areas with appropriate drainage for effective channelling of sewage spills. • Encourage land owners along sewer lines to maintain vegetated belts along the pipeline to control any overflows flows and trap soil. They should be encouraged to take responsibilities at the lowest levels in regard to protecting the sewer line. • Mark clearly the pipeline for ease of identification and protection by the adjacent landowners.

SEWERAGE TREATMENT WORKS

Issue	Summary of Mitigation
Risk of inversion of birds, rodents, mammals and associated reptiles into the waste water ponds	• Keep the Waste Water Treatment Plant (WWTP) clean to limit the attraction of birds which scavenge for insects and maggots from the ponds and sludge beds • The sewage treatment plants should be protected from wildlife encroachments by providing secure barriers to keep off the animals from interfering with the plant operations and safety. this will also ensure safety of the residents, • In the event of larger wildlife e.g. hippos and crocodiles, AWSB and LIWASCO will ensure appropriate consultations with the Kenya Wildlife Services (KWS) on appropriate management actions, • The quality of the discharging sewage into the river will be an important parameter on the regional control of the river eutrophication. Continuous generation and sharing of sewage quality data on pre-scheduled monitoring programmes will be necessary
Air pollution from odour emanating from wastewater treatment works	• Plant trees especially bamboos and eco friendly indigenous trees around the Waste Water Treatment Plant (WWTP) to limit exposure of neighbourhood to adour menace. • Ensure appropriate covering/ventilation of the pre-treatment unit; • Ensure appropriate handling and removal of grit/grease; • Ensure proper sizing and alignment of the lagoons • Ensure scum is appropriately disposed off or properly stabilized; • Ensure that the pond series have adequate water flow and aeration to reduce the potential of odour formation; • The perimeter of the proposed site should be vegetated with trees and plants of varying heights thereby forming windbreaker and reduce dispersion of odour;
Health risks associated with sludge handling and disposal	• Repair the roofs of the sludge drying beds to ensure quick drying of sludge and appropriate disposal to reduce odour emanating from wet sludge. • Provide workers with education and awareness on safe management, handling and application of the sludge cake. This will include appreciation of the materials for soil conditioning to surmount the cultural barrier, • The quality and safety of the sludge cake should be ensured on a collaborative basis with (public health, agriculture, water and soil) before it is released to the users. • Part of ensuring this would be ensuring efficiency of the sludge digestion and effective sludge drying,
Increase in social vices	• Proper security measures should be put in place to guard the equipments 24 hours to reduce cases of vandalism; • The design has proposed a security chain link fence including a gate and guard house be erected at sewerage treatment plant to protect the site from theft and vandalism

E5 Conclusion and recommendation

Through the assessment and evaluation of all environmental concerns of the proposed Limuru Sewerage Project, it can be concluded that the establishment will bring a net ecological, economic, social and health benefits to all living within the Project area. On the other hand, some of the Project components are envisaged to have negative impacts depending on the

different phases and components of the Project. These impacts have been discussed in great details in this report and appropriate mitigation measures proposed.

In order to alleviate the expected negative impacts and to make the Project environmentally sounder, an ESMMP has been prepared, and it includes: the mitigation plan; the monitoring and enforcement requirements; and the responsible persons/organizations. All the recommendations/ mitigations mentioned in the assessment should be financed, and incorporated in the construction and supervision stage and also during operation and maintenance stage of the Project.

E7 Report Structure

This Report has been prepared under the following chapters:

- Chapter 1: Background Information: This Chapter gives description of the Project background, location, purpose, objectives, study methodology, previous studies
- Chapter 2: Project Description: This Chapter gives a description of the status of the Project in the Project cycle, specifically during construction, operation and decommissioning.
- Chapter 3: Baseline Information: This Chapter gives description of the environmental setting of proposed Project and surrounding areas, e.g., climate, soils, geology, vegetation, fauna, land use, human populations and socio-economics of the Project area.
- Chapter 4: Project Alternatives: This chapter gives a description of the Project details of the proposed Project, alternative options, designs and implementation strategies.
- Chapter 5: Policy, Legal and Institutional Framework: This chapter outlines the overview of legislative framework, regulatory, international guidelines and conventions relevant to this project.
- Chapter 6: Stakeholder Consultation: 'This Chapter gives description of the objectives, methods used and summary of results of the public consultation activities.
- Chapter 7: Environmental and Social impacts Assessment and mitigation measures: This chapter presents the analysis of beneficial and adverse impacts of the Project on the biophysical and human (social, cultural and economic) environments. The analysis covers anticipated impacts during the construction, operation phases and decommissioning phases and also describes the enhancement and mitigation measures proposed to enhance benefits or prevent, minimize, mitigate or compensate for adverse impacts as well as the estimated cost of mitigation.
- Chapter 8: Environmental and Social Management and Monitoring Plan: This Chapter presents the Environmental and Social Management and Monitoring Plan prepared for the project.
- Chapter 9: Conclusion and Recommendations: This Chapter briefly presents the environmental and social acceptability of the project, taking into account the impacts, measures and recommendations identified during the assessment process.

MAIN REPORT

CHAPTER 1: BACKGROUND INFORMATION

1.1 General

1.1.1 Background Information

The Project *"Multi Towns Sustainable Water and Waste Water Management Program"* is being developed by the African Development Bank after successful implementation of a similar program referred to as *"Small Towns and Rural Water Supply and Sanitation Project"* was approved by the AfDB in November 2009 to be implemented over four years period to be completed by December 2014 by Tana Water Services Board, Tanathi Water Services Board and Lake Victoria South Water Services Board. The Project overall sector goal was to improve the health and quality of life and reduce poverty levels of the population of Kenya through provision of water and sanitation services on a sustainable basis.

The Project specific purpose was to improve the access, quality, availability and sustainability of water supply and wastewater services in the small towns of Kitui, Siaya, Bondo, Othaya, Mukurwe-ini, Maua and irrigation water for existing Yatta small scale irrigation schemes. Tana Water Services Board under the Project funding successfully implemented and commissioned Othaya, Mukurweni and Maua Water Supply and Sanitation Project.

Athi Water Services Board (AWSB) did not benefit from the project financing under the *Kenya Small Towns and Rural Water Supply and Sanitation Project*, the Board however received a loan towards the implementation of *Nairobi Rivers Basin Rehabilitation and Restoration Program: Sewerage Improvement Project*, the project aim is to rehabilitate and expand sewerage services management of Nairobi city for sustainable environment, the project was successfully implemented by AWSB

Athi Water Services Board (AWSB) has now applied for financing from the African Development Bank (AfDB) under the *"Multi Towns Sustainable Water and Waste Water Management Program* to implement Limuru Sewerage Project. Other Projects planned to be funded include Kiambu, Gatundu and Kikuyu Sewerage Projects.

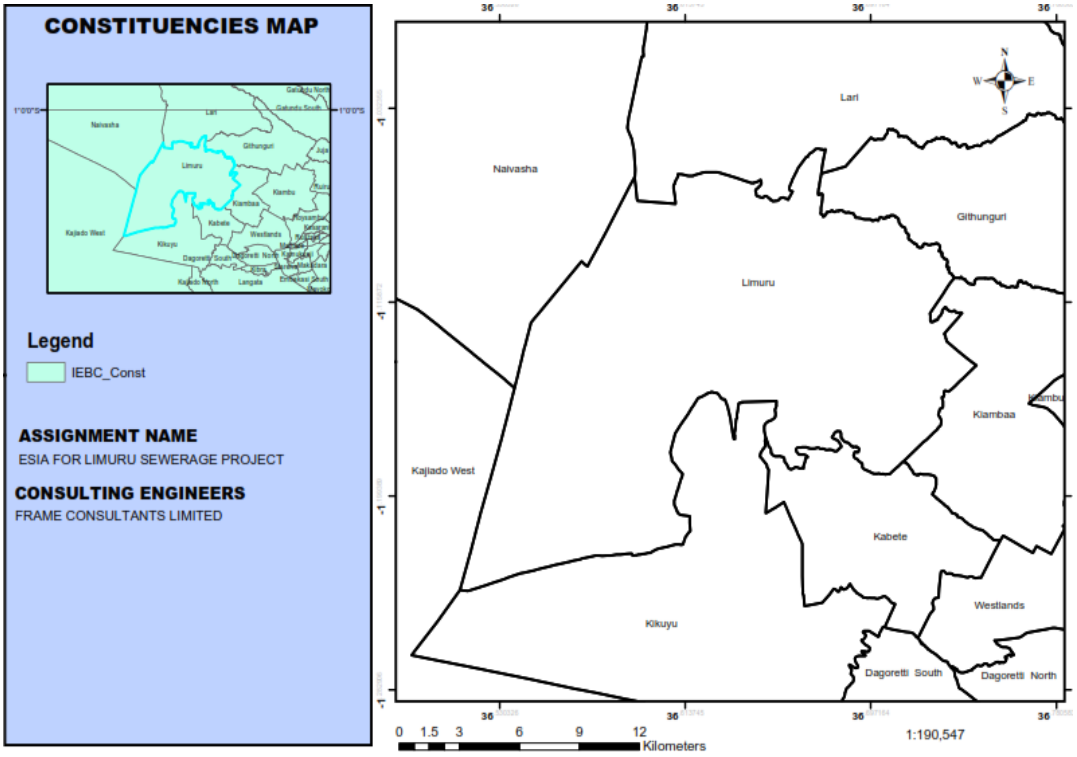
1.2 Project Implementing Authority

The Project is planned to be implemented by Athi Water Services Board (AWSB), the board is among the eight Water Services Boards created under the Water Act 2002 vides Gazette Notice No.1775 of 21st March 2003. The Board's mandate is to ensure efficient and economical provision of water and sanitation services in its area of jurisdiction in line with the Water Act 2002. The principal mandate of the board is to ensure efficient and sustainable provision of quality and affordable water and sewerage services in its area of jurisdiction which covers the city of Nairobi and outlying satellite towns of Gatundu, Kiambu East, Kiambu West, Kikuyu, Ruiru and Thika.

The Board covers an area of 3,810 square km. with a population of 5,515, 738 and a population density of 8472.48 per square km. The Board ensures the provision of quality and affordable water and sewerage services in its area of jurisdiction through its twelve (12) Water Services Providers (WSPs) located in Nairobi, Kiambu, Kikuyu, Thika, Ruiru and Gatundu, namely : Nairobi Water and Sewerage Company; Thika Water and Sanitation Company; Limuru Water and Sewerage Company; Ruiru-Juja Water and Sanitation Company; Kikuyu Water Company; Karuri Water and Sanitation Company ; Gatundu Water and Sewerage Company ; Githunguri Water and Sewerage Company; Gatanga Community Water Scheme ; Kiambu Water and Sanitation Company; band Sanitation Company; and Runda Water Company.

Figure 1 below illustrates general map of Limuru constituency which is the target Project area.

Figure 1: Limuru Constituency Map



Source: IEBC Constituency Map 2013

1.3 Project Justification and Benefits

The project is a direct contribution to Athi Water Services Board (AWSB) strategic plan for the period 2012 – 2017 which aims to improve the number of both rural and urban population with access to water and sanitation services. This is planned under strategic theme 1: Increase Access to Water and Sewerage Services. The plan indentifies the current water and sewerage access in the AWSB area is still low; with access ranging from 44% in the rural areas to 61% for the urban areas. The strategic plan has specific objectives as presented in **Box 1** below;

BOX 1: Strategic Objectives aimed at increasing access to Water and Sewerage Services

- To increase access to safe water in AWSB urban areas from 61% to 86%, and from 44% to 64% in AWSB rural areas by 2017

- To increase sewerage coverage in AWSB area to 84% in urban areas and to 67% in rural areas by 2017.

The Project also addresses improved water supply and sanitation, in small towns and surrounding rural areas, as well as water storage that underpins the Kenyan economic and social developments (Vision 2030) and its associated five years Medium Term Plan (MTP) for 2012 - 2017

The project directly translates to achieving of Sustainable Development Goal (6) which is the new 2030 agenda and expands Millennium Development Goal (MDG) as guided by resolutions of Rio+20 conferences. The goal focuses more on investment in adequate infrastructure in Water Sanitation, Hygiene, Water Quality, Waste Water Management, Water Scarcity and use Efficiency, Integrated Water Resource Management and Protection of Water related Ecosystems

1.4 Objectives and Scope of the ESIA

This ESIA assessment has been conducted in compliance with the Environmental Impact Assessment Regulation as outlined under the Gazette Notice No. 56 of 2003 revised in 2009 established under the Environmental Management and Coordination Act (EMCA), 1999 of Kenya. The Environmental & Social Impact Assessment (ESIA) is expected to achieve the following objectives:

- To identify all potential significant environmental and social impacts of the proposed Project and recommend measures for mitigation.
- To assess and predict the potential impacts during site preparation, construction and operational phases of the project.
- To verify compliance with environmental regulations.
- To generate baseline data for monitoring and evaluation of how well the mitigation measures will be implemented during the project cycle.
- To allow for public participation.
- To give an Environmental and Social Management Plan to mitigate the identified impacts so as to ensure sustainability of the proposed Project.
- To recommend cost effective measures to be implemented to mitigate against the expected impacts.

1.5 ESIA Assessment Methodology

The approach to this exercise was structured such as to cover the requirements under the EMCA, 1999, as well as the EIA regulations as stipulated under the Gazette Notice No. 56 of 13th June 2003 and African Development Bank (AfDB) operational safeguards policies. The assessment involved an understanding of the Project background, the interim designs and the implementation plan as well as Project commissioning. In addition, the baseline information was obtained through physical investigation of the site and the surrounding areas, interviews with a sample of surrounding community, Stakeholder benchmarking photography and most important discussions with the Client and the Design Team.

1.5.1 Environment and Social Scoping

Scoping process involved the identification of significant environmental and social issues associated with the proposed Works. Through reviews of the secondary Documents and available data supported with field evaluations, it was possible to estimate the current status of the water and sanitation infrastructure, implications of additional water into the system, the capacity and integrity of the distribution network and the consumers' locations. Interviews and discussions with stakeholders and Project beneficiaries were applied in determining the aspects such as adequacy of the supply, awareness ownership, willingness to pay for water and general opinions of the people. Significant issues identified through this process have been applied in drawing up the impacts as well as the management plan under this Report.

1.5.2 Desk Reviews

A desktop review was conducted prior to site visit. Documents reviewed include:

- Feasibility Study Reports and Preliminary Designs of the Proposed Project Components
- National Environmental Acts and Regulations (EMCA 1999 and EIA/EA Regulations 2003) and
- African Development Bank (AfDB) Operational Safeguards Policies.

1.5.3 Field Assessment

The physical evaluation of the Project area was carried out with specific focus on the environmental and social issues. The environmental issues assessed include, water sources and water quality, drainage and hydrology, air quality, sanitation and hygiene, biodiversity and sources of environmental pollution. The social issues include; settlement patterns, socio economic activities, land use, presence of traditional/cultural sites in the area. On the social economic front, structured stakeholder consultation meeting were held within the months of September 2015 and June 2016 in some specific areas in addition to rapid interactions with the stakeholders to capture the views of all the parties affected.

1.5.4 Public Participation

The assessment involved consultations with relevant stakeholders in Limuru town. The aim of stakeholder consultations was to give a platform for information sharing and opinion gathering in relation to the proposed project; consultations were done in form of public meetings and key informant interviews. The issues were than analyzed and presented to design team for finalization of Project designs and planning on how best to implement the Project. The main meeting was held within September 2015 and June 2016 in Limuru, attendance of the meetings was from diverse sectors of the society. More consultations are being undertaken in Limuru through the month of June 2016 under the Resettlement Action Plan (RAP) Studies which will lead to development of a Resettlement Action Plan (RAP) which is an annex to this assessment.

1.5.5 Key Informants

During the ESIA process several consultations were conducted with key Informant relevant to the project in the months of September 2015 and June 2016, these informants included County Government Officers, Town Planning Team (TPT), Water Officers, Chamber of Commerce

representatives, Local Administration and representative of LIWASCO

1.6 Socio Economic Survey Methodology

1.6.1 Socio Economic Survey

The survey was conducted in Limuru town with target respondents being the anticipated Project beneficiaries. The information gathered was based on (a) review of secondary data and (b) collection of primary data, both qualitative and quantitative. The qualitative data was gathered through administration of questionnaires and public consultative meetings organized by the area local administration and community members and other stakeholders in the locations.

1.6.2 Household Surveys

The objectives of the household survey was to; understand demographic and economic profile of households within the project locations, know status of and issues related to ownership and tenancy structure, assess resident's access to infrastructure, social amenities, understand environmental conditions, health and various social issues.. This information is important as it help in establishing baseline data required during Project impact evaluation after commissioning.

1.6.3 Social Infrastructure Mapping

Social mapping was undertaken while doing the community survey using full participation from the local administration and community. The focus of the process was to help in the depiction of location boundaries, roads, drainage systems, schools, drinking water facilities, source of drinking water, community infrastructure, etc. It focused on the spatial dimension of the people's realities as expressed in their background information. This process done to help in charting the various aspects related to land use and command areas, water bodies, rivers, drainage.

1.6.4 Sampling Design

The study design relied on probabilistic sample design for selection of households so as to ensure that every single household in the settlement area has a known and non-zero chance being selected into the survey sample. For the household survey, it is quite common to use circular systematic sampling (Systematic sampling is a probability sample selection method in which the sample is obtained by selecting every kth element of the population, where k=N/n, N is population and n is the sample size). The first sampling unit is selected randomly within the first k units of the list. This method for selection of households and the same has been followed in the present study.

1.6.5 Sample Size

For each of the locations, the sample size was determined at 5% level of precision (also called desired margin of error), 95% confidence level and 50% population proportion of response to

key study indicators. The choice of population response proportion is arbitrary; but this is what is assumed to generate the largest possible sample in the absence of a prior knowledge about population response to key study indicators. The sample size was not adjusted for non-response factor. Like in many surveys, non-response of the sampling unit (here household) has been tackled by substituting original sample unit by another.

1.6.6 Survey Questionnaire

The survey questionnaire was designed after reviewing the instruments used in similar kind of household studies in Kenya and prototype survey instruments available from the user guide of the World Bank Group (Preparing Surveys for Urban Upgrading Interventions – Prototype Survey Instrument and User Guide, March 2008). The questionnaire used contains six modules, namely: demographics and household composition; security of housing, land and tenure; settlement profile; economic and employment profile; infrastructure services; and health

1.6.7 Secondary Socio Economic Data

This information was largely drawn from the Kenya National Bureau of Statistic, The Kenya Population and Housing Census VII on Population and Household Distribution by Socio Economic Characteristic, August 2010, Kiambu County Integrated Development Plan (CIP) and findings from household survey undertaken during Environmental and Social Impact Assessment (ESIA) process within the month of June 2016.

CHAPTER 2: PROJECT DESCRIPTION

2.1 Existing Water Supply Infrastructure

The Project area is served by Limuru Water and Sewerage Company established as a private company under the Companies Act, Cap 486 wholly owned by the Kiambu County and was incorporated on 13th March 2006. The Water Company's designated area of supply is 555km². The company currently supplies water to only 40% of the area. The present population under the mandate of the Company is estimated at 119,201 persons, but only a total of 40,230 persons about 34% of the total population, are currently supplied with water. The Locations within the Company's area of jurisdiction are as presented in **Box 2** below

Box 2: LIWASCO Water Supply Locations

- Limuru
- Karambaini
- Ngecha
- Rironi
- Kamae
- Kinale
- Kijabe
- Gitithia
- Lari
- Kirenga
- Gatamiyu
- Nyanduma

The supply system for Limuru includes community operated water supply schemes, boreholes and the company water supply schemes as illustrated in **Box 3** below

Box 3: Existing Water Supply Schemes

- 17 small Self Help Water Schemes, which falls under the relevant District Water Officers.
- Bathi Water Supply Scheme of capacity 20,000m3/day, which serves the main trading Centres of Magina, Kimende, Lari and Uplands.
- Limuru Water Supply Scheme for the Town of Limuru.
- Kijabe Springs which serves part of Kijabe Location

2.2 Existing Sewerage Infrastructure

Limuru Town Sewerage System which serves Limuru Township has a design capacity of treating 550m³/day which is the dry weather flow. The Waste Water Treatment Works (WWTW) was designed in 1974 and was to be implemented in two phases. Phase one was to serve a population of 4,500 persons in 1985. Phase two was to be implemented at a later date to treat sewage from the estimated population of 10,950 in the year 2000, until now phase two has never been implemented. Limuru Water and Sewerage Company (LIWASCO) estimate that nearly 612 m³/day influent is received into the WWTW. The WWTW system is mechanized and the equipment installed is not working properly. It was reported that several electrical equipment such as motors for the aerators gets damaged due to frequent fluctuations in electrical power supply.

The existing sewerage network covers only Limuru Central and therefore most of the developing areas are not served by the sewer system. Some of the areas that have had

tremendous developments taking place include: former Limuru dairy farm with 1,180 house units already approved by the County Government. Limuru Town (CBD) exponential growth, Kamirithu Village, Kamandura /Taramana area, Karanjee/Misiri area, More upcoming industries, Tigoni area and St. Paul University area

The sewer network comprises of approximately 8.3 km of sewers varying in diameters. The existing sewerage network comprises of main trunk mains of DN 300 concrete pipes and DN 160 uPVC laterals. The WSP connects households to inspection chambers which serve several households before connecting to the trunk mains. Due to new developments since construction, the existing network is overloaded. The sewer lines experience frequent blockages. The metal manhole covers are missing in some areas since they were vandalized and stolen. **Figure 2** below illustrates components of existing sewerage treatment plant

Figure 2: Components of existing sewerage treatment plant

	
Inspection Manhole before sewage flows to the screens.	Screening: 40 mm x 4 mm steel bars
	
Sludge drying beds	Settling tanks equipped with rotating half bridge supporting scraper arms with scraper blades

The final effluent from the existing treatment facility does not the standards required for discharge into the environment, the final Biological Oxygen Demand (BOD) as high as 50m/l instead of required 30m/l as indicated in **figure 3 below**

Figure 3: Quality of Effluent from the Treatment Plant

Name of Customer: LIMURU WATER AND SEWERAGE COMPANY. Address: .....

Purpose of Sampling MONITORING County: KIAMBU

Date of Sampling: 26/9/14 Date Received 26/9/14

Source FINAL EFFLUENT LIMURU WATER AND SEWERAGE COMPANY. Date Compiled: 7/4/15

PARAMETERS	UNIT	RESULTS	EFFLUENT STANDARDS	
			DISCHARGE INTO ENVIRONMENT	DISCHARGE I PUBLIC SEW
Temperature	°C	22.7	±3 ambient temp.	20-30
pH	pH Scale	7.95	6.5-8.5	6-9
Conductivity	µ S/cm	1352	-	-
BOD5 days at 20 °C	mgO_2/l	50	30	500
COD	mgO_2/l	109	50	1000
Total Alkalinity	$mgCaCO_3/l$	480	-	-
Total Suspended Solids	mg/l	67	30	250
Total Dissolved Solids	mg/l	838	1200	2000
Sulfides as S^{2-}	mg/l	<1	0.1	2
Oil + Grease	mg/l	-	Nil	5 or 10
4 Hr Permanganate Value	mgO_2/l	6	-	-
Salinity	ppt	0.68	-	20
Nitrate	mgn/l	-	-	-

2.3 Land Requirement / Ownership

The project is divided in two components as illustrated in table 1 below. The purpose of categorizing the project was to have a clear analysis of the environment and social impacts and also to clearly analyze land requirement for the project as described below.

Table 1: Project Components

Project Component	Description	Land Requirement
Component 1	Sewer Pipelines and associated works	• No land requirement needed sewer Lines to be constructed within road reserves • RAP has been prepared to address compensation requirements for project impacts on private assets and sources of livelihood encroaching into road reserve
Component 2	Waste Water Treatment Plant works	• No Land extra land required, the augmentation works and expansion works to be restricted within existing Kiambu County Government land for the WWTW

2.4 Proposed Sanitation Intervention [2]

2.4.1 Drainage Pattern and Sewerage Zones

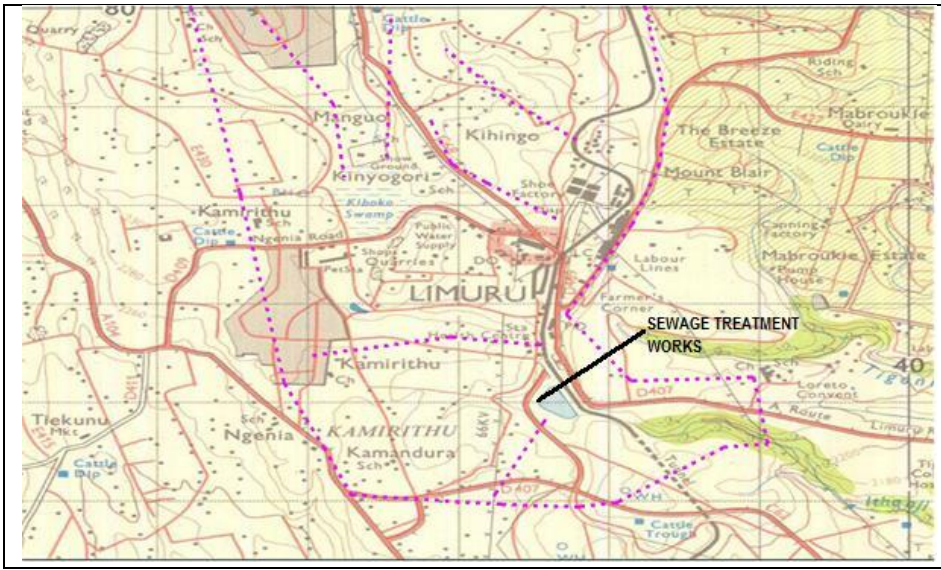
[2] Project Description in this section is based on Preliminary Design Report Prepared by Frame Consultants Limited June 2016

The drainage pattern of the Limuru is such that the entire area can drain into the Ithanji River. However, due to the flat terrain in the upper parts of the project area, Swamps are common e,g, Manguo (Kiboko) Swamp as indicated in the photo plates below.

Photo Plate 1: Drainage Basins within Limuru area

The natural drainage pattern in the area and the surrounding areas is as shown in **Figure 4** that follows below

Figure 4 Drainage Pattern of Limuru



2.4.2 Waste Water Treatment Plant Locations

The existing sewerage system drains into one point located about 1 km south of Limuru Town. This location is located next to a swamp that marks the start of the Ithanji River. The proximity of this site to the main township means that developments southwards of the town will have to have onsite sewage treatment systems. Locations of the sewage treatment plants will dictate the trunk sewers routes, lengths and cost. The following options have been considered

OPTION I: Dandora Estate Sewage Treatment Works (Nairobi):

This option entails draining the sewage generated in the project area to the 160,000m3/d

Dandora Estate Sewage Treatment Works in Ruai.

This can be achieved by construction of a 34km long Trunk sewer along the Ithanji-Ruiruaka River system to join the existing Ruaraka Trunk Sewer. In doing so, this trunk sewer will also serve Runda Estate, Ruaka Area, Muchatha Shopping Center, Banana Hills Shopping Center, Limuru Country Club and Limuru Township. The estimated cost for this proposal is as follows;

Figure 5: Cost Estimates for implementation of Option I

		Unit	Quantity	Rate (KES)	Amount (KES)
1	Ithanji-Ruiruaka River Trunk Se	m	34,000	15,000.00	510,000,000.00
2	Reticulation Sewers	m	31,000	9,000.00	279,000,000.00
3	Wayleave easement and RAP	m^2	510,000	750.00	382,500,000.00
					1,171,500,000.00

Advantages:

- No new sewage Treatment Plant to be built.
- Faster construction time of only sewerlines.
- More urban areas within the Kiambu and Nairobi will be covered by gravity.

Disadvantages:

- Land easement issues within the posh estate areas of Runda
- Limuru Country Club may complicate the project.
- Need to reconstruct the Ruaraka River Trunk Sewer to accommodate the additional sewage flows.

OPTION II: Tigoni Sewage Treatment Works (Proposed):

This option entails acquisition of land 7km downstream of Limuru Town just after the Tigoni Dam that is used by the Limuru Golf Club.

Figure 6: Cost Estimates for implementation of Option II

		Unit	Quantity	Rate (KES)	Amount (KES)
1	Ithanji River Trunk Sewer	m	7,000	15,000.00	105,000,000.00
2	Reticulation Sewers	m	31,000	9,000.00	279,000,000.00
3	Construction of STW	m^3	5,700	50,000.00	285,000,000.00
4	Acquisition of Land for STW	Ha	10	20,000,000.00	200,000,000.00
5	Wayleave easement and RAP	m^2	105,000	750.00	78,750,000.00
					947,750,000.00

Advantages:

- More areas within the Limuru area will be covered by gravity
- Adequate and cheaper land within the Tea Estates makes use of cheap
- Waste Stabilization Ponds (WSP) feasible.

Disadvantage:

- Land easement issues with the Tea Estate in Tigoni can delay project implementation,

OPTION III: Limuru Sewage Treatment Works (Existing):

This option entails use of the existing location. The existing treatment works can handle only 500m3/d and will therefore require to be expanded in the neighbouring available land to 5,900m3/d capacity.

Figure 7: Cost Estimates for implementation of Option III

		Unit	Quantity	Rate (KES)	Amount (KES)
1	Trunk Sewers Rehabilitation	m	1,000	17,500.00	17,500,000.00
2	Reticulation Sewers	m	31,000	12,000.00	372,000,000.00
3	Rehabilitation of existing STW	Sum	-	-	75,000,000.00
3	Construction of New STW	m^3	5,700	50,000.00	285,000,000.00
					749,500,000.00

Advantage:

- No land acquisition or/and wayleave easement issues

Disadvantages:

- Limited land available therefore mechanized sewage treatment methods to be used as opposed to cheaper waste stabilization ponds,
- Only areas upstream of Limuru Town can be added to the system by gravity.

RECOMMENDATION

From the above three (3) options, it is recommended to adopt OPTION III that entails use of the available site based on the listed advantages and disadvantages as well as the capital cost comparisons.

Areas past 1km downstream of Limuru Town will not be covered by the proposed system. Further, the areas downstream are currently mostly occupied by Tea Plantations, Golf Club and rural areas with small shopping centres. These can be served by onsite sanitation solutions like septic tanks and pit latrines.

2.4.3 Sewer Network

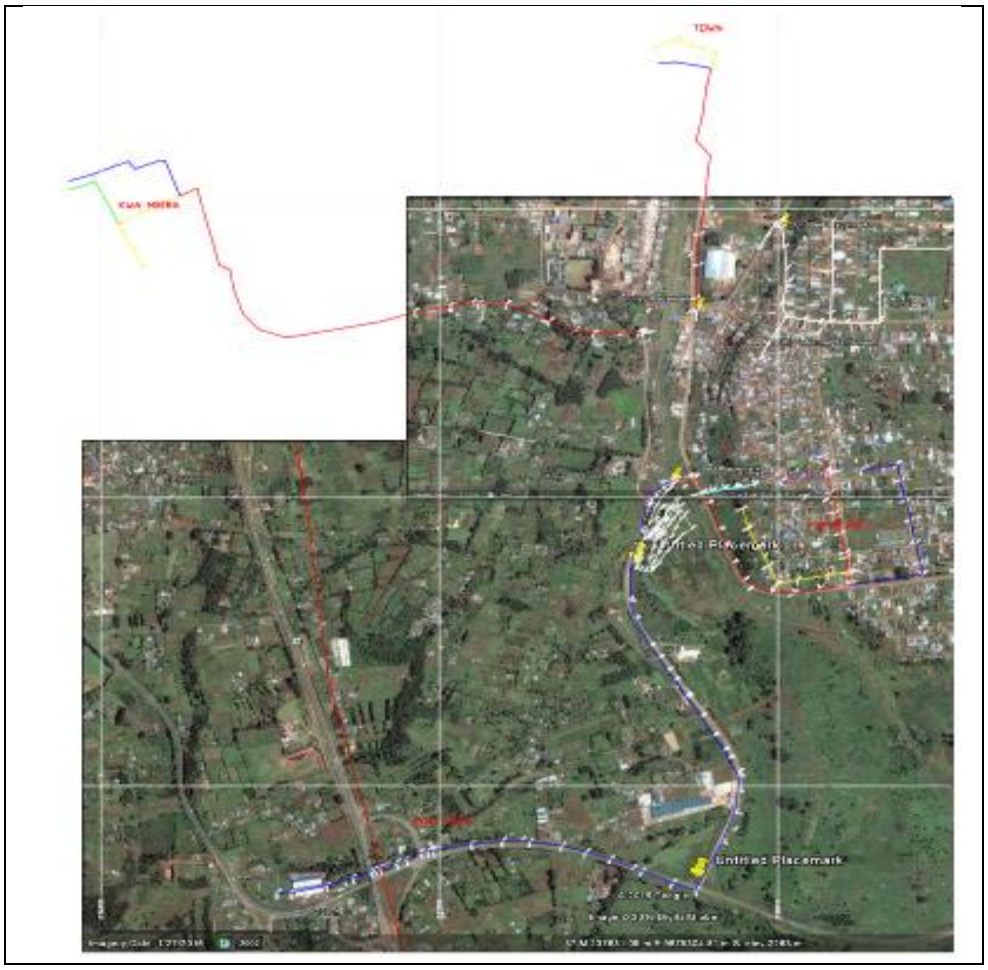
The sewer in Limuru covers most of the developed areas. However, this systems are overloaded and/or broken down and do not function as designed. The recommended scope of work for Limuru sewers include rehabilitation and upgrading of the existing sewerage network that will comprise the following:

- Rehabilitation of sections of existing sewer lines which require flushing & unblocking,
- Replacement of missing sewer inspection manholes covers,
- Rehabilitation of existing sewer inspection chambers,
- Extension of the existing sewers to cover Karanjee, Kwambira, Bibirioni

Figure 8: Illustrates Existing Sewerage Network for Limuru

Figure 9: below Illustrates the Proposed Sewerage Extensions targeted to cover the developed area Kwa Mbira, Kamirithu, Limuru Town towards Bata Shoe Company side and Karanjee area.

Figure 9: Proposed Sewerage Network Extension



2.4.4 Waste Water Treatment Technology

The following sewage treatment methods have been found appropriate for use in the Limuru Project area presented in **Box 3**

Box 3: Sewerage Treatment Technologies

- Waste Stabilisation Ponds,
- Aerated Lagoons,
- Oxidation Ditches,
- Percolating/Trickling Filters,
- Combined Anaerobic Ponds-Trickling Filters Process.

To achieve the required faecal coliform standard, the following methods of treating the effluent have been identified;

- Use of a Constructed wetland,
- Rock, gravel and Sand layers filtration,
- Use of maturation ponds.

i. Waste Water Stabilization Process

These are large basins enclosed by earthen embankments in which raw sewage is treated by entirely natural processes involving both algae and bacteria. These are simple to construct and operate. Their construction requires materials entire found and made in Kenya. Their disadvantage is that they require relatively large areas of land. The treatment process using waste stabilization ponds has been proposed to comprise of Anaerobic Pond, Facultative Pond and Maturation Ponds.

The cost of constructing waste stabilization ponds, excluding other facilities, is shown in **Figure 9** that follows.

Figure 9: Design aspects and cost for implementation of Waste Stabilization Ponds

Process Units	Influent BoD_5 (mg/l)	Effluent BoD_5 (mg/l)	Land Required (Ha)	Constructio Cost (KES)
Anaerobic Ponds	330.14	151.87	0.23	20,238,350.8
Facultative Ponds	151.87	52.17	3.09	125,852,594.4
1st Maturation Ponds	52.17	26.09	1.26	56,740,547.9
2nd Maturation Ponds	26.09	13.04	1.26	56,740,547.9
			5.84	259,572,041.1

ii. Aerated Lagoons

These are completely mixed non-return activated sludge units consisting of basin where oxygen is supplied by means of Floating or fixed surface aerators or diffused-air aeration units as the wastewater flows

Figure 10: Design aspects and cost for implementation of Aerated Lagoons

Process Units	Influent BoD_5 (mg/l)	Effluent BoD_5 (mg/l)	Land Required (Ha)	Construction Cost (KES)
Aerated Lagoons	330.14	168.24	0.65	98,466,064.3
Settling Tanks	168.24	67.30	0.04	63,108,800.0
1st Maturation Ponds	67.30	33.65	1.99	84,774,027.7
2nd Maturation Ponds	33.65	16.83	1.99	84,774,027.7
			4.67	331,122,919.8

iii. Oxidation Ditches

This is a modification of the conventional activated sludge process suitable for small communities. The aeration tanks are in the form of long continuous channels, oval in plan and with rotor suspended over the channel for aeration, mixed liquor propulsion and prevention of suspended solids from settling. This is the existing sewage treatment system in Limuru with a design capacity of 500m3/d.

Figure 11: Design aspects and cost for implementation of Oxidation Ditches

Process Units	Influent BoD_5 (mg/l)	Effluent BoD_5 (mg/l)	Land Required (Ha)	Construction Cost (KES)
Oxidation Ditches	330.14	168.24	0.5	81,782,392.5
Settling Tanks	168.24	67.30	0.04	63,108,800.0
1st Maturation Ponds	67.30	33.65	1.99	84,774,027.7
2nd Maturation Ponds	33.65	16.83	1.99	84,774,027.7
			4.52	314,439,248.1

iv. Percolating Filters

These consist of tanks containing inert filter media which provides a large surface for the growth of the biological organisms responsible for treatment. Aerobic conditions are provided by natural ventilation. The primary wastewater is distributed on top surface of the media, and then flows through the media where the bio-organisms feed on the organic material in the passing wastewater. In the project area, it is proposed to use the following two processes;

- A high rate trickling filters system that include a primary settling tank, high rate filters, secondary settling tanks, low rate filters and Final clarifiers, or,
- A low rate percolating filters system that incorporates a primary settling tank, low rate filters and secondary settling tanks.

Figure 12: Design aspects and cost for implementation of High rate Percolating Filters

Process Units	Influent BoD_5 (mg/l)	Effluent BoD_5 (mg/l)	Land Required (Ha)	Construction Cost (KES)
Primary Settling Tanks	330.14	214.59	0.02	56,554,400.0
High Rate Percolation Filters	214.59	64.38	0.05	48,386,000.0
Intermediate Settling Tanks	64.38	41.85	0.02	56,554,400.0
Low Rate Percolation Filters	41.85	14.65	0.04	44,708,800.0
Secondary Settling Tanks	14.65	9.52	0.01	53,277,200.0
1st Maturation Ponds	9.52	7.14	2.18	91,947,513.3
2nd Maturation Ponds	7.14	5.35	2.18	91,947,513.3
			4.50	443,375,826.6

Figure 13: Design aspects and cost for implementation of Low rate Percolating Filters

Process Units	Influent BoD_5 (mg/l)	Effluent BoD_5 (mg/l)	Land Required (Ha)	Construction Cost (KES)
Primary Settling Tanks	330.14	214.59	0.02	56,554,400.0
Low Rate Percolation Filters	214.59	53.65	0.26	125,607,200.0
Secondary Settling Tanks	53.65	34.87	0.01	23,277,200.0
1st Maturation Ponds	34.87	26.15	2.18	91,947,513.3
2nd Maturation Ponds	26.15	19.61	2.18	91,947,513.3
			4.65	389,333,826.6

v. Combined un-aerobic and Low rate trickling filters

This combines anaerobic ponds preceding high rate filters. The effluent is treated in maturation ponds for bacteriological control prior to discharge into the receiving water course. It's proposed to have an arrangement consisting of Anaerobic Ponds, low rate filters and settling tanks.

vi. Figure 14: Design aspects and cost for implementation of Ponds and Filter system

Process Units	Influent BoD_5 (mg/l)	Effluent BoD_5 (mg/l)	Land Required (Ha)	Constructio Cost (KES)
Anaerobic Ponds	330.14	198.08	0.27	23,178,404.4
Low Rate Percolation Filters	198.08	49.52	0.33	151,347,600.0
Secondary Settling Tanks	49.52	32.19	0.02	26,554,400.0
1st Maturation Ponds	32.19	24.14	2.18	91,947,513.3
2nd Maturation Ponds	24.14	18.11	2.18	91,947,513.3
			4.98	384,975,431.0

2.4.5 Recommended Treatment Process

From the above preliminary design and costing of the various possible sewage treatment processes, the following were the findings.

i. The Waste Stabilization Ponds System has the lowest capital cost followed by

Oxidation Ditches. Percolating Filters systems have the highest capital cost.

ii. The waste stabilization ponds system has the lowest operational and maintenance cost of all options identified. The main disadvantage of adopting waste stabilization ponds system for Limuru is the limitations of land available. The available land is less than 5Ha, half of which is currently under the 500m3/d treatment Plant and associated works.

iii. The next cheapest option is the Oxidation Ditch system. This process is the one currently in use in Limuru and the staff must be well versed with the technical know-how. It also has the second lowest land requirements. It is therefore proposed that an Oxidation Ditch System be implemented.

2.4.6 Effluent and Sludge Disposal

The effluent will be disposed of in the nearby swamp which shall also assist in further purification of the effluent. Sludge shall be dried in open air drying beds and sold to the nearby tea farms as manure

2.4.7 Sanitation Infrastructure Estimated Project Cost

The following table shows the preliminary cost estimates for implementation of the sewerage scheme for Limuru Town. Detailed justification of the cost will be found in the Engineers Estimates.

Figure 15 : Proposed Investment Cost

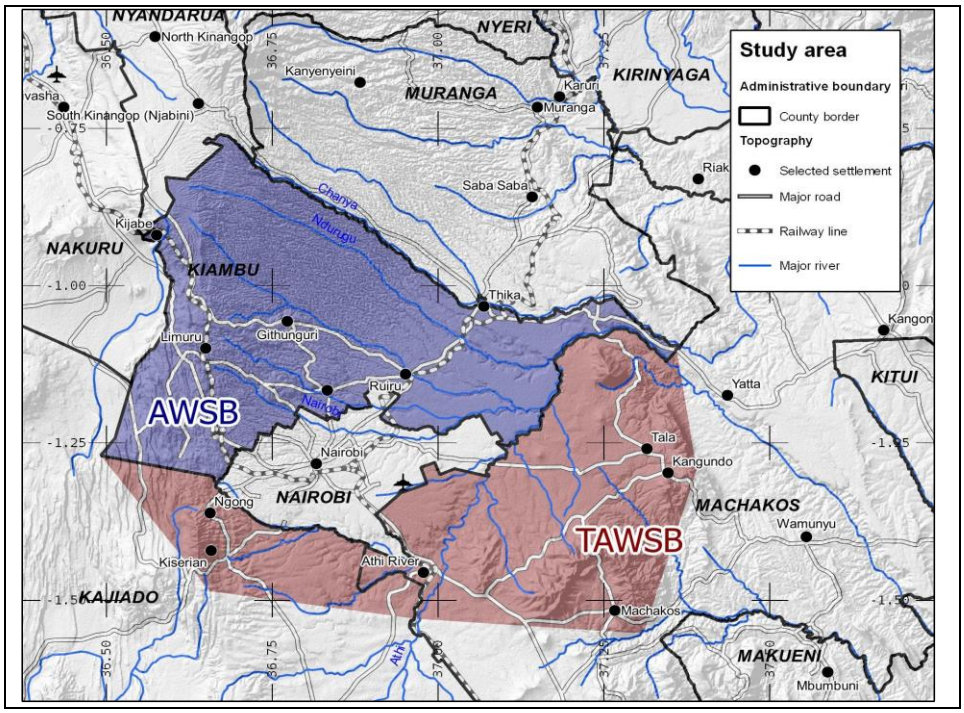
Description	Amount (KES)
New Secondary and Reticulation Sewers	280,800,000.00
Rehabilitation of existing Sewers	5,000,000.00
Rehabilitation of existing STW	40,000,000.00
Construction of New STW	300,000,000.00
Sub-Total (1)	**625,800,000.00**
Preliminary and General Items	60,000,000.00
Engineering Services	50,000,000.00
Sub-Total (2)	**735,800,000.00**
Contigent Amount	73,580,000.00
	809,380,000.00

CHAPTER 3: BASELINE INFORMATION

3.1 Location of the Project

Limuru town is located within Kiambu County which is one of the 47 counties of Kenya, the overall population of the county estimated at 1,623,282 populations according the 2009 census report from the Ministry of Planning and National Development and an annual growth rate of 2.3% per annum. The County has a total Square Kilometer of 2543.4 km^2 major towns in the county include Kiambu Thika Kikuyu, Limuru, Githunguri and Gatundu which is the target project area. The main tourist attractions within the county are Mau Mau Caves, Chania Falls, Aberdare Forest, fourteen Falls Mugumo Garden and Christina Wangare Gardens. **Figure 16** below illustrates the overall satellite image of Kiambu County.

Figure 16: Satellite Image of Kiambu County



(Source: Google Earth 2012)

3.2 Physical Environment

The physical environment of Limuru is presented in the sub chapters below, the sub-sections below briefly describe the physical, biophysical, social and cultural environment of the Project area, while chapter 7 of this report presents the likelihood of the project activities to alter or impact the indentified physical environment physical parameters discussed.

3.2.1 Climate

The climate of Limuru is highly influenced by Aberdares Forest Ecosystem; Limuru is located on the Eastern side of the Southern edge of Aberdare Escarpment as it drops into the Rift Valley. The region is characteristic by equatorial climatic conditions and rainfall is highly influenced by altitude and comes in two seasons, long rains between March to May and short rains between October and December. The annual mean rainfall varies from 1070mm to 1750mm per annum. The area has steep slopes which enable run off the easily flow by gravity

through the drainage channels to the main river course which the RuiRwaka river basin system

Temperature is also influenced by altitude due to the Aberdare ranges. Mean annual temperature varies from low in higher regions to high in lower region between 17 and 25 degrees Celsius. Humidity and Evaporation - wind direction is easterly and evaporation ranging from 100 to 150mm per month while the humidity varies between 50% and 90%.

3.2.2 Topography

The project area is characterized by steep slope and deep valleys, physiographic of the region is influenced by Aberdare ranges with topography varying from steep in the western region and undulating landforms volcanic ranges in the Northern. The sewer plant is situated at an elevation 2147m and GPS coordinated UTM UPS 37 M 0237565 and 9876272 gently sloping towards RiuRwaka. Elevations drops by almost 10m from the Kimende which the highest area anticipated to be served therefore enabling sewer to flow by gravity, however for effective flow of sewer within the treatment works pumping system has been introduced.

3.2.3 Geology and Soils

The geology of the area is part of the Eastern Border Zone of the Rift Valley, filled with kainozonic volcanic and sediments underlying the upper Athi generating good aquifers. Soils on the other hand develop from weathering activities of the volcanic rocks and are highly fertile with high levels of perforation.

Typical tropic red soils (Latosols) are also dominant in some sections within the project area, They have a high clay content, a thin, but fertile, humus layer and a distinct aggregate structure. These characteristics make them resistant to soil erosion. The soils of the gentle to sloping slops of the middle and low altitudes are covered by light red soils. There are also a lot of patches of grey soils (Gleysols, "vlei soils"). Shallow, stony soils are located on the steep slopes around the channels. The flat areas are swampy. Soil erosion and mass movement are one of the major problems in the catchment.

3.3 Hydrology

The project area is well drained both horizontally because of the horizontal valleys, vertical slopes and loamy red volcanic soils which are porous and allow for all infiltration, the ranges are covered by tea zones. Due to this, cases of flooding are not likely to happen. Clearing of vegetation on the steep slopes is strictly discouraged as flush surface runoff is likely to dominate the region. The catchments are constituted by lower Aberdare ranges feeding to the numerous rivers and streams around.

3.3.1 Surface Water Resource

Limuru Town is generally endowed with numerous springs, streams and marshland that constitute RuiRwaka River and Tigoni Dam which is serve the project area. The river provides the main source of water to the residents of Limuru who use the water either directly for irrigating farmlands, most of the abstraction points indentified area unauthorized by the Water Resource Management Authority.

3.3.2 Ground water Resources

The main sources of water in the region are the 17nr boreholes with an approximate combined production of 3,000 m3/day, Bathi Water Supply Scheme is supplied by water from Bathi dam with an average production of 1,150 m3/day and Thigio Rural Scheme with an average production of 600 m3/day. **Table 2** below presents exiting data of boreholes within Limuru

Table 2: Existing Boreholes

Borehole No.	Borehole Name	Year Drilled	Drilled Depth (m)	Tested Yield (m^3/hr)	Present Yield (m^3/hr)	Daily Pumping Hours	Present Production (m^3/day)
Details not available	Kibarage	Oct-07	250	3.9	3	12	36
C128	Uplands	May-05	128	27.4	22.5	20	450
C94	Ruhia	Details not available		14	14	12	168
C4587	BH No. 5	Aug-08	144	30	25	16	400
C4550	BH No. 3	Details not available	190	24	20	16	320
C4578	BH No. 4		103.75	23	20	16	320
C5787	DC Residence		144	6	6	16	96
Details not available	Tigoni		Details not available		4	16	64
C5561	BH No. 6		110	18	20	16	320
Details not available	Water Supply		Details not available		20	16	320
	Tutu				4	12	48
	Nguirubi				30	16	480
	Boroti				4	12	48
					Total Daily Present Production m^3/d		**3,070**

Surface Water Sources

- Bathi Dam, Capacity: 20,000 m^3/d
- Kijabu Springs
- Details of Production are not available

Source: Nairobi and Satellite Towns Water Supply Master Plan 2012

3.4 Biological Environment

3.4.1 Vegetation and Flora

Biodiversity of the Project location is highly influenced human activities, the area lies within Agro-Eco-zone III and IV where agriculture is the main economic activity practiced by people, tea and coffee farming is the main cash crop grown, other crops include cabbages, irish potatoes and dairy farming. Trees are used mainly for shade, boundary demarcation, fencing, and production of fruits, timber, and fuel wood and for ornamental purposes. Common trees in the district include: Eucalyptus spp, Markhamialutea, Cupressuslusitanica, Bischoviajavonica, Croton megalocarpus and Pinup sp. Common fruit trees are Perseaamericana, Syzygiumguminii and Eryobotria japonica. Shrubs include lantana camara, Tethoniadiversifolia and Solanum incanum.

Limuru town enjoys close proximity to Nairobi, the town is located approximately 18km from Nairobi Central Business District, population pressure and housing demand pressure has resulted to landowners changing land use from original agricultural use to real estate and housing units. This pressure has resulted to clearing of coffee plantations and woodlots around the town in an effort to provide land for establishment of housing units.

3.4.2 Fauna

Human habitation and agricultural activities have also significantly interfered with both

terrestrial and aquatic habitats in the Project areas. There is no terrestrial wildlife observed in the Project areas since most land is under agricultural use for many years pushing the animals into the Aberdare Forest. Animals in the area are mainly domestic animals such as cattle, sheep, goats, pigs and poultry.

3.5 Social Setup

3.5.1 Population

Limuru is located within Kiambu County which is one of the 47 counties; Kiambu County had a population of 1,623,282 according the 2009 census report from the Ministry of Planning and National Development. The County has a total Square Kilometer of 2543.4 km2 major towns within the County include; Kiambu,Thika, Kikuyu, Limuru, Githunguri and Gatundu. According to the Kenya National Bureau of Statistics (KNBS) Report, the total population for the Project area (Limuru and Satellite centers) was 16,400 in 2015 and projected to increase to 35,486 in 2038 at a population grow rate of 2.3% per annum.

3.5.2 Settlement Patterns

The settlement patterns are in Limuru and environs are influenced by rural to urban migration, good infrastructure and proximity to Nairobi. Majority of the population reside within Limuru Township which is the main market centre. The project area is densely populated and land is subdivided into small sizes. Currently, there is a high rate of change of user of land from agricultural to residential due to high housing pressure from Kiambu and Nairobi towns.

3.5.3 Land Use Patterns

Land tenure is majorly free hold; land near the urban centres has been subdivided in plots while land size away from the urban centres has minimum subdivisions. Majority of the land within the outskirts of the town belong to coffee and tea companies and societies which are still utilizing for agricultural purposes

The area supports both large- and small-scale agriculture. The Northern and Western parts of the town receive the highest amount of rainfall, and tea, coffee and dairy farming are common. Some irrigated farming is also undertaken in the drier eastern areas of the district. It also consists of the urban area, surrounded by a mix of industrial, commercial and agricultural land-use, major companies within the project area are; Bata Shoe Company, Limuru milk processors and Polypipes.

3.5.4 Socio Economic Condition

The assessment of socio economic conditions of Limuru Township was assessed during the study; table xx below presents a summary of the findings.

i. Household Characteristic

The socioeconomic survey covered a sample of 128 households drawn from Limuru Town, Karanjee, Kwambira and Bibirioni. The survey sought views from household heads or adult members found in the household at the time of the interview. Among the respondents interviewed, 51% were women while 49% were male. Where the household heads were not found the spouses or adult children responded to the household questionnaire.

ii. Assets Ownership by Gender

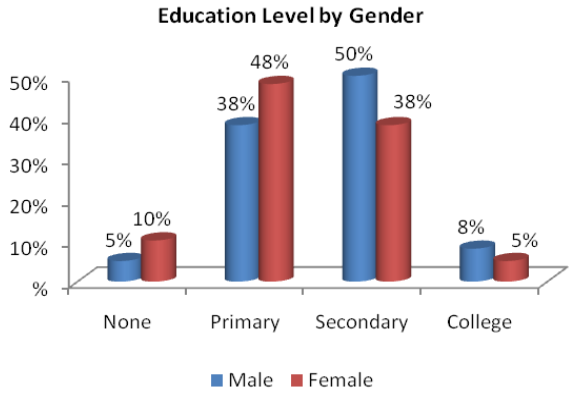
Majority of respondents were tenants (67%) compared to 33% of the landlords who own the plots, due to population pressure land parcels have been subdivided and rental structures constructed by the landowners who wish to take advantage of the high house demands The areas are well planned with residents having title deed to the parcels they occupy (freehold) from Kiambu County Government Analysis of structure owners by gender across the sample revealed that 68% are owned by male while 32% are owned by female.

iii. Education Level

Across the sample size, the survey noted that 83% of the households in Limuru are male headed while 27% are female headed. The average household size across the sample size is 4 members. In regard to education, for the 128 self-reported household heads, the highest education level achieved by majority of the household heads (47%) is secondary school, 41% primary school level, 7% college level while 6% have not attained any level of education at all.

Analysis of education level across gender revealed that women are still trailing behind the men within the various levels of education mentioned. For instance, taking the highest education level to be secondary, only 38% of the women reported to have at least attained secondary school education as compared to 50% of the male household heads interviewed, despite having majority of the female at the primary level category. During the focus group discussions, low transition to secondary schools and other levels of education among female was associated with a number of factors such as early marriages, child abuse, early pregnancy, as well as limited financial resources. **Figure 17** below present's education level by gender

Figure 17: Education Level by Gender



iv. Occupation of the Household Head

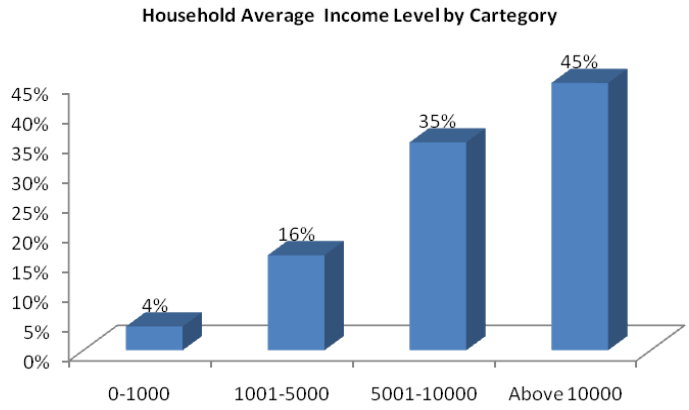
Analysis of the household head against their occupations revealed that 47% within the sample size derive their livelihoods from self employed, 38% farmers, 12% are permanently employed and 3% are unemployed.

Analysis of occupation by gender revealed that slightly more men than women in Limuru are in self-employment at (52%) compared to 48% male. Some of reasons given for this disparity were cited as over indulgence of men in illicit brew and drugs thus neglecting family responsibilities, presence of a significant number of single mothers who have to provide for their children as well as increasing cost of living forcing women to supplement household income.

v. Income Levels

According to self-reported income levels, the average household monthly income in Kiambu was estimated at KES 12,000 drawn from a minimum of KES 1,050 and a maximum of KES 48,000. Analysis of household income by category revealed that a significant proportion of the households earn slightly over KES 10,000 while only 4% earn KES <1,000 per month The Average amount earned as daily wage per household was reported as KES 700. **Figure 18** presents income levels of respondents

Figure 18: Income Level of Respondents



vi. Development Priorities

An assessment of development priorities within the project area (Limuru) ranked water high on the list of respondents' perceived development priorities. Water and sewer comes ahead as a priority amongst 13 development social problems mentioned by the respondents, based on the results of the pair-wise matrix rankings done with 20 community members as shown below in **table 3**:

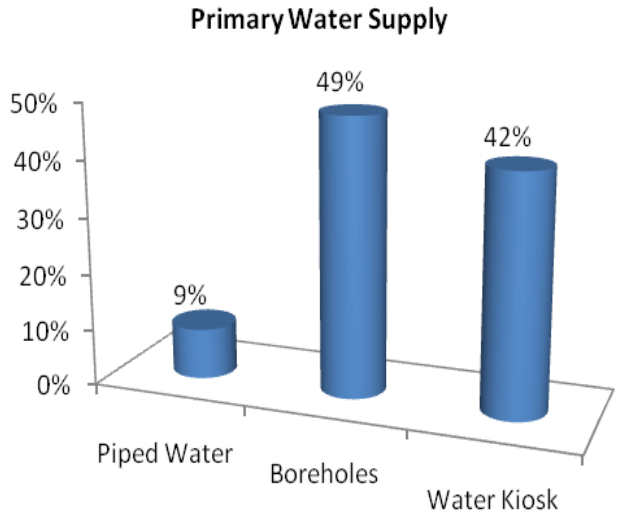
Table3: Pair-wise Ranking Results

Social Problem	Score	Rank
Water	24	1
Schools	15	4
Roads	14	6
Playing Field	0	13
Health Facilities	13	7
Excreta Facilities	23	2
Sewerage	17	3
Security	9	8
Vocational facilities	8	9
Illicit Brew	2	12
Unemployment	5	11
Rehabilitation Facilities	6	10
Child Abuse	15	4

vii. Water Services

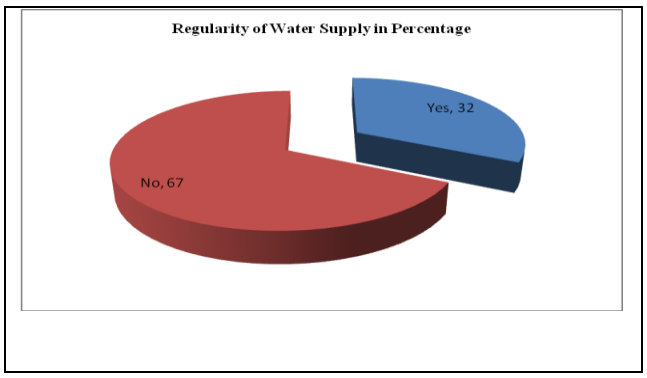
Service level is a measure of water availability and accessibility, which therefore measures the extent of hardship for a given community. Water availability refers to general reliability while accessibility relates to proximity, ease of fetching and affordability. Based on this definition, the survey analyzed the current water situation among the households in Limuru using water service level indicators among them access, quantity, quality, distance and time as well as cost. **Figure 19** illustrates water supply options

Figure 19: Water Supply Options



The respondents confirmed that few areas in Limuru receive water from LIWASCO. Primary water sources in Limuru are 17 small Self Help Water Schemes, Bathi Water Supply Scheme of capacity 20,000m3/day, which serves the main trading Centres of Magina, Kimende, Lari and Uplands, Limuru Water Supply Scheme for the Town of Limuru and Kijabe Springs which serves part of Kijabe Location. It was further reported that the supply is not adequate and residents go for days without receiving water figure **20** illustrates water supply frequency

Figure 20: water Supply Frequency



viii. Regularity of Water Supply

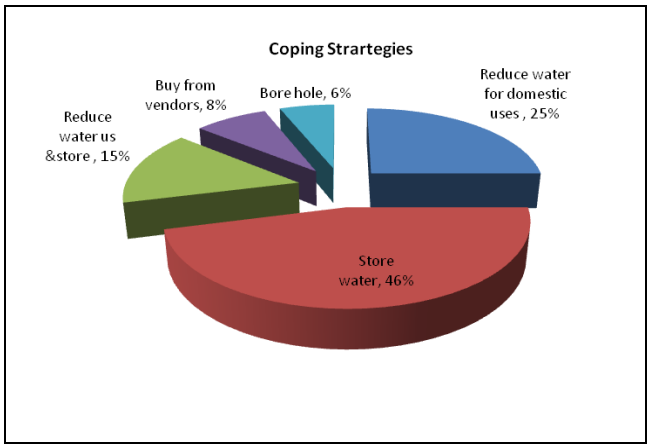
Defining irregularity of water supply as the times when water supply is low or when there is lack of water for more than two days in a week, the survey sought to establish whether residents in the Limuru experienced an irregular water supply at the time of the survey. The survey noted that most of the water sources in Limuru provide a regular water supply as

reported by 59% of the respondents as compared to 41% who reported an irregular supply. Further analysis on the number of hour's water is available indicated that at least 64% of the residents can at least access water for 12 hours per day for 7 days in a week as compared to 36% are experience irregular supply. Such availability can be explained by the fact most of the sources in Limuru are point sources mainly boreholes that accessible throughout the day.

ix. Coping Strategies

Residents of Limuru adapt various strategies to cope with insufficient water supply. Those mentioned include reducing the amount of water used for domestic chores, water storage as well as buying from vendors. **Figure 21** indicates alternative water supply options

Figure 21: Alternative Water Supply Options



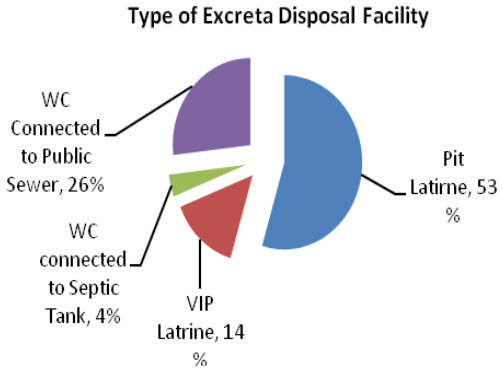
x. Environmental Sanitation

Environmental sanitation in this baseline survey assessed the current situation of excreta disposal, household garbage and liquid waste management.

The socio economic survey recognizes that inadequate sanitation leads to a number of financial and economic costs including direct medical costs and loss of productivity[3] at household level hence the need for more investments towards its improvement. Data and information collected in Limuru shows that the area has no sewer line connection except for small sections within Limuru Town hence the reside rely on onsite systems mainly pit latrines, for excreta disposal many of them built and maintained by the landlords. **Figure 22** shows alternative waste disposal methods

Figure 22: Alternative Waste Disposal Methods

[3] UNICEF,2008: Africa Water and Sanitation



Number of people sharing the Facility

Most of the excreta disposal facilities in Limuru are found within the plots. The average number of households sharing a facility was estimated to be 6 households. Based on the number of people per household, this translates to 18 people per facility.

Overall Satisfaction

Respondents' overall rating of the current excreta disposal facilities revealed low satisfaction levels among majority of the respondents as evident by 32% and 47%% of the respondents in Limuru who gave a rate of very dissatisfied and dissatisfied respectively.

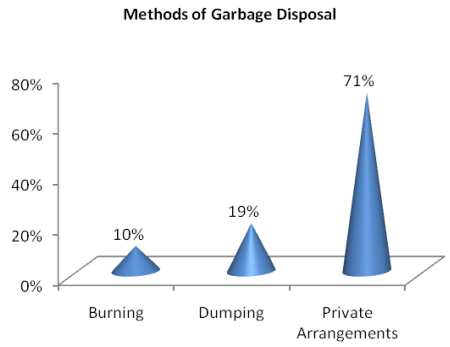
Household Solid Waste Management

Wastewater management, solid waste management, urban drainage and other environmental and sanitary services have a great influence on the water supply system in any given area. The following is an outline of the current situation in regard to solid and liquid waste management in Limuru

xi. Garbage Disposal

The common methods of household garbage disposal in Limuru were observed as burning, dumping while majority of the residents have private arrangements with some local CBOs who collect garbage on weekly basis at a cost of KES 10 per household. For those who dispose through dumping, common dumping places were identified as along the roads, river as well as outside the compound. **Figure 22** shows garbage disposal methods

Figure 22: Garbage Disposal Methods



xii. Health and Hygiene

Residents self reported identified the following as the common diseases among children, women and men in Limuru as illustrated in **table 4**

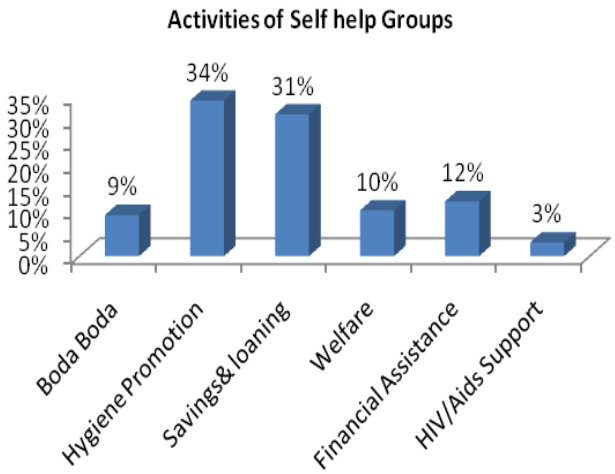
Table 4: Common Diseases and their Causes

Category	Prevalent Disease	Major Cause
Children	Diarrhea, Malaria, Skin conditions, Bronchitis, pneumonia and coughing Malnourishment,	Poor sanitation and hygiene practices Lack of treated drinking water Congestion Poor feeding
Women	Typhoid& amoeba Tuberculosis STIs & HIV/AIDS Malnourishment	Poor sanitation and hygiene practices Congestion Poor feeding Irresponsible behaviors'
Men	Typhoid and malaria Tuberculosis HIV/AIDS and STIs Diabetes	Poor sanitation and hygiene practices Congestion Irresponsible behavior Consumption of excessive alcohol

xiii. Gender Empowerment

Empowerment is a multi-dimensional social process that helps people gain control over their own lives. It is a process that fosters power in people for use in their own lives, their communities, and their society, by acting on issues they define as important. Self-help groups can be one way to achieve some level of gender empowerment as many of them are formed for the purpose of pooling resources, gathering information, and offering mutual support for their members. **Figure 23** indicates gender based activities

Figure 23: Gender Activities



In line with this understanding, the assessment established that there are a number of self-help groups present in Limuru undertaking various activities. Further analysis on the extent household's members engage into membership of various local self-help groups denoted that within a sample of 128 households, only 27% are engaged in a self-help group while the majority (73%) are not. Various factors motivate people to engage in various self-help groups.

xiv. Willingness to Pay for Improved Levels of Service

The yard tap and house connection options were assumed to require upfront deposits of KES 9,000 and KES 5,000 respectively. Recurrent fees would be KES 18 per m3 and 15 m3 for yard tap and individual connection respectively. The improved kiosk system would ensure a facility within 100 metres of the house, operated by an attendant throughout the day and a cost of KES 2 per twenty litre jerrican as indicated in **table 5**

Table 5: Willingness to Pay by Income Level

	Preferred Option			
Income Level	**Private Connection for Household**	**Improved Yard Tap Connection**	**Improved System of Water Kiosks**	**Not to Change my Present Connection**
0-1000	20.0%	40.0%	20.0%	20.0%
1001-5000	23.8%	47.6%	28.6%	.0%
5001-10000	20.0%	64.4%	13.3%	2.2%
Above 10000	33.3%	49.1%	15.8%	1.8%

Findings of the survey denote that about 54% of the households interviewed prefer the yard connection while 27% expressed preference for individual connections. Notably, 20% of those within an income category of KES 0 – 1,000 prefer status quo to any of the proposed improvements. Besides the connection deposit being considered too high, respondents advanced various reasons why they did not prefer private water connection and yard taps. These include the monthly payment being prohibitive, the size of the house being too small to accommodate the reticulation infrastructure and problem of sharing bills especially among the yard tap users.

Across the various income categories and among those stating high deposit as a prohibitive factor to ownership of an individual connection, the survey sought to document how much deposit residents would be willing to pay. The **table 6** below outlines the findings:

Table 6: Affordable Deposit for House Connection and Yard Tap by Income Category

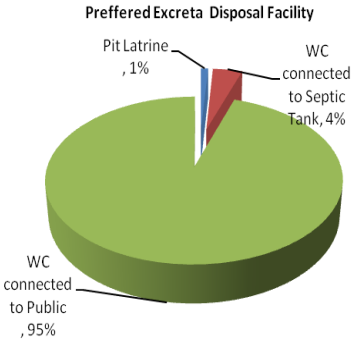
Income Level	Affordable Deposit for Individual Connection	Affordable Deposit for Yard Connection
1,001-5,000	1961.00	1625.00
5,001-10,000	1910.53	2833.00
Above 10,000	2250.00	3666.00

xv. Preference and Willingness to Pay for Sanitation Improvement

Out of the 128 households interviewed, 84% reported to have thought of changing their system of excreta disposal to an improved one. Among the various options available to the residents, the most preferred is the water closet connected to the public sewer. Reasons advanced for the preference included high hygiene level and easy maintenance. Willingness to pay for the improvement was expressed by 92% of the residents interviewed as opposed to

8% who did not. Monthly payment is the most preferred method of payment for 96% while 4% prefer the Pay as you Use method. The average amount people are willing and able to pay was cited as KES 2 for Pay as You Use and KES 300 for the monthly charge. **Figure 24** indicates the common excreta disposal

Figure 24: Excreta Disposal Methods



CHAPTER 4: PROJECTA LTERNATIVES

4.1 Project Alternative

This section in the ESIA study report cross examined the proposed project against available feasible alternative, this analysis is often undertaken in order to determine whether the project can be implemented within an alternative which is sustainable than the one presented by the preliminary feasibility studies and engineering designs. In this chapter, consideration was made based on alternative parameters listed below.

- Project Location
- Project Technology
- Project Impacts to People Assets and Sources of Livelihood

Ultimately, after subjecting the project to the above mentioned option analysis, deduction was made between the Project Option alternative or No Project Option alternative. Sub chapters below present in summary criteria that will be considered during project options assessment

4.2 Project Location

Three options were considered in location of the project are discussed in chapter 2 if this assessment, a summary is presented below.

OPTION I: Dandora Estate Sewage Treatment Works (Nairobi):

This option entails draining the sewage generated in the project area to the 160,000m3/d Dandora Estate Sewage Treatment Works in Ruai.

This can be achieved by construction of a 34km long Trunk sewer along the Ithanji-Ruiruaka River system to join the existing Ruaraka Trunk Sewer. In doing so, this trunk sewer will also serve Runda Estate, Ruaka Area, Muchatha Shopping Center, Banana Hills Shopping Center, Limuru Country Club and Limuru Township. The estimated cost for this proposal is Ksh 1,171,500.00 for Ithanji – Ruaka River trunk, reticulation sewers and way leave and RAP cost.

Advantages:

- No new sewage Treatment Plant to be built.
- Faster construction time of only sewer Lines.
- More urban areas within the Kiambu and Nairobi will be covered by gravity.

Disadvantages:

- Land easement issues within the posh estate areas of Runda
- Limuru Country Club may complicate the project.
- Need to reconstruct the Ruaraka River Trunk Sewer to accommodate the additional sewage flows.

OPTION II: Tigoni Sewage Treatment Works (Proposed):

This option entails acquisition of land 7km downstream of Limuru Town just after the Tigoni Dam that is used by the Limuru Golf Club. The estimated cost is 947, 500,000.00 for Ithanji River Trunk, Land acquisition for establishment of the ponds and way leave RAP cost

Advantages:

- More areas within the Limuru area will be covered by gravity
- Adequate and cheaper land within the Tea Estates makes use of cheap
- Waste Stabilization Ponds (WSP) feasible.

Disadvantage:

- Land easement issues with the Tea Estate in Tigoni can delay project implementation,

OPTION III: Limuru Sewage Treatment Works (Existing):

This option entails use of the existing location. The existing treatment works can handle only 500m3/d and will therefore require to be expanded in the neighbouring available land to 5,900m3/d capacity. The estimated cost is Kshs 749,500.00 for Trunk Sewer, Reticulation, and rehabilitation of existing sewer plant and construction of new sewer plant

Advantage:

- No land acquisition or/and way leave easement issues

Disadvantages:

- Limited land available therefore mechanized sewage treatment methods to be used as opposed to cheaper waste stabilization ponds,
- Only areas upstream of Limuru Town can be added to the system by gravity.

RECOMMENDATION

From the above three (3) options, it is recommended to adopt OPTION III that entails use of the available site based on the listed advantages and disadvantages as well as the capital cost comparisons. Areas past 1km downstream of Limuru Town will not be covered by the proposed system. Further, the areas downstream are currently mostly occupied by Tea Plantations, Golf Club and rural areas with small shopping centres. These can be served by onsite sanitation solutions like septic tanks and pit latrines.

4.3 Project Technology

Chapter 2 of this assessment describes in detail the technologies considered in selection appropriate sewerage treatment technology for Limuru, These technologies are described below.

4.3.1 Waste Water Stabilization Process

These are large basins enclosed by earthen embankments in which raw sewage is treated by entirely natural processes involving both algae and bacteria. These are simple to construct and operate. Their construction requires materials entire found and made in Kenya. Their disadvantage is that they require relatively large areas of land. The treatment process using waste stabilization ponds has been proposed to comprise of Anaerobic Pond, Facultative Pond and Maturation Ponds. The cost is estimated to be Kshs. 259,572,041

4.3.2 Aerated Lagoons

These are completely mixed non-return activated sludge units consisting of basin where

oxygen is supplied by means of Floating or fixed surface aerators or diffused-air aeration units as the wastewater flows. The cost is estimated to be Kshs. 331,122,918.

4.3.3 Oxidation Ditches

This is a modification of the conventional activated sludge process suitable for small communities. The aeration tanks are in the form of long continuous channels, oval in plan and with rotor suspended over the channel for aeration, mixed liquor propulsion and prevention of suspended solids from settling. This is the existing sewage treatment system in Limuru with a design capacity of 500m3/d. The cost is estimated to be Kshs. 314,439,248

4.3.4 Percolating Filters

These consist of tanks containing inert filter media which provides a large surface for the growth of the biological organisms responsible for treatment. Aerobic conditions are provided by natural ventilation. The primary wastewater is distributed on top surface of the media, and then flows through the media where the bio-organisms feed on the organic material in the passing wastewater. In the project area, it is proposed to use the following two processes;

- A high rate trickling filters system that include a primary settling tank, high rate filters, secondary settling tanks, low rate filters and Final clarifiers cost estimated at Kshs. 443,375,826
- A low rate percolating filters system that incorporates a primary settling tank, low rate filters and secondary settling tanks cost estimated at Kshs. 389,333,826

4.3.5 Combined un-aerobic and Low rate trickling filters

This combines anaerobic ponds preceding high rate filters. The effluent is treated in maturation ponds for bacteriological control prior to discharge into the receiving water course. It's proposed to have an arrangement consisting of Anaerobic Ponds, low rate filters and settling tanks cost estimated at Kshs. 384,975,431

Recommended Treatment Process

From the above preliminary design and costing of the various possible sewage treatment processes, the following were the findings.

iv. The Waste Stabilization Ponds System has the lowest capital cost followed by Oxidation Ditches. Percolating Filters systems have the highest capital cost.

v. The waste stabilization ponds system has the lowest operational and maintenance cost of all options identified. The main disadvantage of adopting waste stabilization ponds system for Limuru is the limitations of land available. The available land is less than 5Ha, half of which is currently under the 500m3/d treatment Plant and associated works.

vi. The next cheapest option is the Oxidation Ditch system. This process is the one currently in use in Limuru and the staff must be well versed with the technical know-how. It also has the second lowest land requirements. It is therefore proposed that an Oxidation Ditch System be implemented.

Table 7 overleaf presents more analysis of advantages and disadvantages of various sewerage treatment technologies

Table 7: Description Comparison of Alternative Wastewater Treatment Methods

Treatment Process	Standard of Treatment	Process Reliability	Process Complexity	Operation & Maintenance Requirements	Land Requirements	Civil Construction Requirements	M & E Equipment	Sludge Production	Environmental Considerations
Waste Stabilization Ponds	Good, except for nutrient removal	Very Good, but climate dependent	Extremely simple. No skills needed	Very limited and simple	large areas of land needed	very simple	Almost none. except possibly at the inlet works	Limited sludge production. Sludge is stable and requires no further treatment	High environmental acceptance
Aerated Lagoons	Good., except for nutrient and bacterial removal	Good, but partly subject to power outages and mechanical failure	Very simple. No skills needed	Limited and straight forward	High land requirements, but not as large as WSPs	Very simple	Apart from the inlet works, only the surface aerators	Limited sludge production. Sludge is stable and requires no further treatment	Moderate environmental acceptance
Biological Filters	Very Good., except for nutrient and bacterial removal	Good, subject to power outages and mechanical failure	Simple. Limited skills needed	Moderate, but straight forward	Moderate land requirements	Complicated RC structural requirements	Moderate degree of M&E plant needed	Sludge from primary & secondary settlement needs treatment	Some aspects need further environmental consideration
Activated Sludge	Very Good., except for nutrient & bacterial removal	Good, subject to power outages & mechanical failure	Complex Highly skilled manpower needed	High requirement for O&M and skilled staff	Moderate land requirements	Very Complicated RC structural requirements	High input of M&E equipment needed	Sludge from primary & secondary settlement needs treatment	Many aspects need further environmental consideration
Oxidation Ditch	Very Good., except for nutrient & bacterial removal	Good, but subject to power outages & mechanical failure	Simple Limited skills required	Moderate requirement for skilled O&M staff	Moderate land requirements	Moderate construction requirements	Moderate degree of M&E plant needed	Limited sludge production. Sludge stable & requires no further treatment	Some aspects need further environmental consideration

Notes: 1. All treatment processes except waste stabilization ponds require additional treatment such as and filtration and disinfection or maturation to achieve bacteriological reduction
2. All treatment processes considered will require additional process units to achieve nutrient removal
3. The activated sludge process and the oxidation ditch most easily lend themselves to nutrient reduction using Modified Activated Sludge (MAS) process

4.4 Project Resettlement Issues

Acquisition of easement for lying the sewer pipelines and land for expansion of existing sewerage treatment plant was analyzed for proposed project interventions in Limuru, this was don order to indentify the most appropriate routes for the sewer lines which do not impact on private assets and sources of livelihood.

The following measures were adopted to minimize project impact to private assets and sources of livelihood and the need for land acquisition and resettlement impacts, the measures include.

- The adopted technology (oxidation ditches) for augmentation and rehabilitation of the existing Limuru Waste Water Treatment Plant did not trigger the need for additional land, proposed works will be done within the existing plant premises.
- Trunk sewer, secondary sewers pipelines are planned to be located within existing way-leaves and riparian land.

4.5 Project Option Alternative

The Project shall directly result to realization of benefits described in section 1.4 of this assessment summarized as

- The Project shall lead to realization AWSB strategic goals of improving sewerage coverage in AWSB area to 84% in urban areas and to 67% in rural areas by 2017, the Project is among the initiatives of the board towards achieving the strategic goal above.

- The Project addresses improved water supply and sanitation, in small towns and surrounding rural areas, as well as water storage, for water supply and irrigation development, that underpins the Kenyan economic and social developments (Vision 2030) and its associated five years Medium Term Plan (MTP) for 2012 – 2017

- Sustainable Development Goal (6) which is the new 2030 agenda and expands Millennium Development Goal as guided by resolutions of Rio+20 conference. The goal focuses more on investment in adequate infrastructure in water sanitation, Hygiene, water quality, waste Water Management, water scarcity and use efficiency, integrated water resource management and protection of water related ecosystems

4.6 No Project Alternative

The No Project Option in respect to the proposed Project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. Therefore if the Project is not implemented, the following issues are most likely to continue affecting residents of Limuru town.

- There will be no improved Health and Sanitation within the target beneficiaries

- There will be no improved living standard/well-being, employment and local economy in the target beneficiaries
- There will be no creation of employment during both construction and operation phases of the projects

From the above analysis, it becomes apparent that the No Project alternative is no alternative to the community.

CHAPTER 5: POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

5.1 Introduction

Development of infrastructure projects is dealt with under several laws, By-laws, regulations and Acts of parliament, as well as policy documents and it is not possible to bring all those statutes under one heading. This section is therefore aimed at assessing the existing policies and legislative framework, economic tools and enforcement mechanisms for the management of infrastructure projects at different stages. In so doing, the discussion will be based on the following legislations and policy provision

5.2 Policy Provision

5.2.1 Constitution of Kenya

Article 42 of Bill of Rights of the Kenyan Constitution provides that every Kenyan has a right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislation and other measures.

Part II of Chapter 5 of the Constitution (Environment and Natural Resources), (I) the State clearly undertakes to carry out the following:

- Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
- Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
- Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
- Encourage public participation in the management, protection and conservation of the environment; Protect genetic resources and biological diversity;
- Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
- Eliminate processes and activities that are likely to endanger the environment; and

Part (II) “Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

Chapter 5 on Land and Environment emphasizes on the following:

- Land use and management shall by law benefit local communities
- Community land is protected from encroachment by State.
- Law shall protect Rivers, forests and water bodies.
- Equitable access to land.
- All lawful land rights are secured; only someone who has stolen land needs to worry.
- County governments will manage land in trust of the people in accordance with the constitution.

Relevance

The constitution of Kenya provides for sound management and sustainable development of all of Kenya's projects, both public and private investments. It also calls for the duty given to the Project proponent to cooperate with State organs and other persons to protect and conserve the environment as mentioned in Part II.

5.2.2 Kenya Vision 2030

Kenya Vision 2030 is the current national development blueprint for period 2008 to 2030 and was developed following on the successful implementation of the Economic Recovery Strategy of Wealth and Employment Creation which saw the country's economy back on the path to rapid growth since 2002. GDP growth rose from 0.6% to 7% in 2007, but dropped between 1.7% and 1.8% in 2008 and 2009 respectively.

The objective of the vision 2030 is to "transform Kenya into a middle income country with a consistent annual growth of 10% by the year 2030". One of this aims is to make Kenya to be a nation that has a clean, secure and sustainable environment by 2030. This will be achieved through promoting environmental conservation to better support the economic pillar.

Kenya's transformation in to a middle income country will be achieved by bringing and improving basic infrastructure and services namely: roads, street lights, storm water drains, footpaths, and water and sanitation facilities among others. This Project aims at improving the sanitation services in Limuru town through the construction sewerage project.

5.2.3 National Environment Policy (NEP)

Sessional Paper No. 6 of 1999 on Environment and Development since adoption by parliament in 1999 has been in use and influenced the formation of EMCA in 1999 but has since been surpassed by time and is therefore under revision to comprehensively cover areas that were previously left out to augment it.

The revised draft of the National Environmental Policy, dated April 2012, sets out important provisions relating to the management of ecosystems and the sustainable use of natural resources, and recognizes that natural systems are under intense pressure from human activities particularly for critical ecosystems including forests, grasslands and arid and semi-arid lands. The objectives of the Policy include developing an integrated approach to Environmental management, strengthening the legal and institutional framework for effective coordination, promoting environmental management tools.

Relevance

The Project shall implement the Environmental and Social Management and Monitoring Plan (ESMMP) to mitigate the impacts of the resulting impacts during the construction and operational phases of the project, this will ensure that the sensitive ecosystems are not destabilized by the subsequent Project activities.

5.2.4 National Land Policy

Chapter 2 of the policy is linked to constitutional reforms; regulation of property rights is vested in the government by the Constitution with powers to regulate how private land is used in order to protect the public interest. The Government exercises these powers through compulsory acquisition and development control. Compulsory acquisition is the power of the State to take over land owned privately for a public purpose. However, the Government must make prompt payment of compensation.

Chapter 4 of the land policy under Environmental Management Principles, The policy provides actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution.

For the management of the urban environment it provides guidelines to prohibit the discharge of untreated waste into water sources by industries and local authorities; it also recommends for appropriate waste management systems and procedures, including waste and waste water treatment, reuse and recycling. This Project aims at improving the management of waste water before discharge to water sources serving other areas of downstream users.

The policy goes further to advocate for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried out on all land developments that may degrade the environment and take appropriate actions to correct the situation. Public participation has been indicated as key in the monitoring and protection of the environment.

Chapter 4 further advocates for the Implementation of the polluter pays principle which ensures that polluters meet the cost of cleaning up the pollution they cause, and encourage industries to use cleaner production technologies.

5.2.5 HIV and AIDS Policy 2009

The proposed project is to be implemented in the Informal Settlements which have high freelance cases of HIV and Aids. This policy shall provide a framework to both the project proponent and contractor to address issues related to HIV and Aids. In Summary the policy provides a mechanism for:

- Setting Minimum Internal Requirements (MIR) for managing HIV and AIDS
- Establishing and promoting programmes to ensure non-discrimination and non-stigmatization of the infected;
- Contributing to national efforts to minimize the spread and mitigate against the impact of HIV and AIDS;
- Ensuring adequate allocation of resources to HIV and AIDS interventions;
- Guiding human resource managers and employees on their rights and obligations regarding HIV and AIDS.

5.2.6 Gender Policy 2011

The overall goal of this Policy Framework is to mainstream gender concerns in the national development process in order to improve the social, legal/civic, economic and cultural conditions of women, men, girls and boys in Kenya

The policy provides direction for setting priorities. An important priority is to ensure that all ministerial strategies and their performance frameworks integrate gender equality objectives and indicators and identify actions for tackling inequality. In addition, each program will develop integrated gender equality strategies at the initiative level in priority areas. Within selected interventions, the policy will also scale-up specific initiatives to advance gender equality

This policy will be referred to during project implementation especially during hiring of staff to be involved in the project, procuring of suppliers and sub consultants and sub contractors to the project

5.3 Kenya Legislations

5.3.1 The Environmental Management and Coordination Act (EMCA) 1999

The Act provides for the establishment of a Legal and Institutional Framework for the management of the environment and for matters connected therewith and incidental thereto. Just as in the new constitution, Part II of EMCA confers to every person the right to a clean and healthy environment and to its judicial enforcement.

The new Constitution and EMCA therefore obligates the project's Executing Agency and Contractor to work in a clean environment and not to contravene the right of any person within its zone of influence, to this entitlement. EMCA has provided for the development of several subsidiary legislations and guidelines which govern environmental management and are relevant to the Project implementation.

These include:

i. **The Environmental (Impact Assessment and Audit) Regulations, 2009 Legal Notice No. 101.**

The Environmental Impact Assessment and Audit Regulations state in Regulation 3 states that "the Regulations should apply to all policies, plans, programmes, projects and activities specified in Part IV, Part V and the Second Schedule of the Act. Part III of the Regulations indicates the procedures to be taken during preparation, submission and approval of the environmental Project report.

Relevance

Part 4(1) of the Regulation further states that: "no Proponent shall implement a project"

(a) Likely to have a negative environmental impact; or

(b) For which an environmental impact assessment is required under the Act or these Regulations, unless an environmental impact assessment has been concluded and approved in accordance with these Regulation.

ii. **The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121.**

These Regulations were published in the Kenya Gazette Supplement No. 69, Legislative

Supplement No. 37, and Legal Notice No. 121 of 29th September, 2006. The regulations provide details on management (handling, storage, transportation, treatment and disposal) of various waste streams including:

- Domestic waste;
- Industrial waste;
- Hazardous and toxic waste;
- Pesticides and toxic substances;
- Biomedical wastes; and
- Radioactive waste.

Regulation No. 4 (1) makes it an offence for any person to dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. Regulation 5 (1) provides categories of cleaner production methods that should be adopted by waste generators in order to minimize the amount of waste generated and they include:

- Improvement of production process through
- Conserving raw materials and energy;
- Eliminating the use of toxic raw materials and wastes;
- Reducing toxic emissions and wastes.
- Monitoring the product cycle from beginning to end by
- Identifying and eliminating potential negative impacts of the product;
- Enabling the recovery and re-use of the product where possible, and
- Reclamation and recycling and
- Incorporating environmental concerns in the design and disposal of a product.

Regulation 6 requires waste generators to segregate waste by separating hazardous waste from non-hazardous waste for appropriate disposal. Regulation 15 prohibits any industry from discharging or disposing of any untreated waste in any state into the environment. Regulation 17 (1) makes it an offence for any person to engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment license issued by NEMA.

Relevance

The proposed project, during construction phases will generate wastes which will need to be disposed of as per the guidelines in the regulations.

iii. **The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120.**

These Regulations were published in the Kenya Gazette Supplement No. 68, Legislative Supplement No. 36, and Legal Notice No. 120 of 29th September, 2006. The Regulations provides for sustainable management of water resources including prevention of water pollution and protection of water sources (lakes, rivers, streams, springs, wells and other water sources). It is an offence under Regulation No. 4 (2), for any person to throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution. Regulation No. 11 further makes it an offence for any person to discharge or apply any poison, toxic, noxious or obstructing matter, radioactive waste or other pollutants or permit the dumping or discharge of such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive

waste or pollutant complies with the standards for effluent discharge into the environment.

Relevance

During the construction and maintenance phases, the proposed Project will discharge its final effluent into nearby streams and rivers. The discharge must comply with the standards specified in this regulation before being allowed into the river in order to protect the rivers ecological function.

iv. **The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61.**

These regulations were published as legal Notice No. 61 being a subsidiary legislation to the Environmental Management and Co-ordination Act, 1999. The regulations provide information on the following:

- Prohibition of excessive noise and vibration;
- Provisions relating to noise from certain sources;
- Provisions relating to licensing procedures for certain activities with a potential of emitting excessive noise and/or vibrations and
- Noise and excessive vibrations mapping.

According to regulation 3 (1), no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Regulation 4 prohibits any person to (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source.

Regulation 5 further makes it an offence for any person to make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.

Regulation 12 (1) makes it an offence for any person to operate a motor vehicle which (a) produces any loud and unusual sound; and (b) exceeds 84 dB(A) when accelerating. According to sub-regulation 2 of this regulation, No person shall at any time sound the horn or other warning device of a vehicle except when necessary to prevent an accident or an incident. Regulation 13 (1) provides that except for the purposes specified in sub-Regulation (2) there under, no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or steam or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the Second Schedule to these Regulations.

Regulation 19 (1) prohibits any person to carry out activities relating to fireworks, demolitions, firing ranges or specific heavy industry without a valid permit issued by the Authority. According to sub-regulation 4, such permit shall be valid for a period not exceeding three months.

Relevance

The contractor /sub contractor for civil works will be required to ensure compliance with the above regulations in order to promote a healthy and safe working environment throughout the construction phase. This shall include regular inspection and maintenance of equipment and prohibition of unnecessary hooting of vehicles

v. The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160.

Part II of Regulations, section 4 states that no person shall engage in any activity that may have adverse impacts on ecosystems, lead to introduction of exotic species or lead to unsustainable use of natural resources without an EIA license. The regulation puts in place measures to control and regulate access and utilization of biological diversity that include among others banning and restricting access to threatened species for regeneration purposes. It also provides for protection of land, sea. Lake or river declared to be a protected natural environmental system in accordance to section 54 of EMCA, 1999.

Other relevant EMCA 1999 to be considered during construction and operation of the Project are;

- Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009.
- The Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations, 2006 Legal Notice No. 131;
- The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73.

Relevance to the Project

EMCA 1999 and above listed regulations shall form the main statutory instruments which will guide the implementation of the Project so that any likely adverse impacts that could be caused by the Project are promptly mitigated as recommended in this assessment. This report also in compliance with the requirement of the EIA/EA regulations

5.3.2 Water Act 2002

The Act is currently under review to align the water sector with the new constitution now Water Bill 2014, however, it vest the responsibility of developing water and Sanitation infrastructure (sewerage and water supply) to Athi Water Services Board (AWSB)

Section 73 of the Act allows a person with a license to supply water (licensee) to make regulations for purposes of protecting against degradation of sources of water which he is authorized to take. Under the Act, the licensee could be a local authority, a private Trust or an individual and the law will apply accordingly under the supervision of the Regulatory Board.

Section 75 and sub-section 1 allows a licensee for water supply to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing water belonging to the licensee or which he is authorized

to take for supply from being polluted. However, if the proposed works will affect or is likely to affect any body of water in the catchment, the licensee shall obtain consent from the Water Resources Management Authority.

Section 76 states that no person shall discharge any trade effluent from any trade premises into sewers of a licensee without the consent of the licensee upon application indicating the nature and composition of the effluent, maximum quantity anticipated, flow rate of the effluent and any other information deemed necessary. The consent shall be issued on conditions including the payment rates for the discharge as may be provided under section 77 of the same Act.

Relevance to the Project

This Act shall be relevant during both construction operation phases of the Project whereby the contractor and proponent shall ensure that all relevant water resources are not polluted from both liquid and solid wastes. AWSB shall also obtain authorization by WRMA before discharging treated sewer into the river channels.

Water Rules 2007

One of the outcomes of the water sector reforms has been improved regulatory framework for water resource management and use. In addition to the Water Act 2002, the main document outlining the regulations is the Water Resource Management Rules 2007. The rules set out the procedures for obtaining water use permits and the conditions placed on permit holders. Sections 54 to 69 of the Water Resources Management Rules 2007 impose certain statutory requirements on dam owners and users in this regard.

Other sections within the rules imply that WRMA can impose water quality sampling requirements from the water sources and impacts to the hydrology, water chemistry and river morphology downstream basin. Section 16 of the Water Rules requires approval from the Water Resources Management Authority (WRMA) for a variety of activities that affect the water resources, including the storage of water in dams and pans. Approval by WRMA is conferred through a Water Permit. A permit is valid for five years and must be renewed.

Section 104 of the Water Resource Management Rules requires certain water permit holders to pay water use charges. The intention of the water use charges was to raise revenue for water resource management, raise revenue for catchment conservation activities, improve efficiency of water resource abstraction and provide a system of data collection on water resource usage.

5.3.3 County Government Act No. 17 of 2012

Part II of the Act empowers the county government to be in charge of function described in Article 186 of the constitution, (county roads, water and Sanitation, Health), Part XI of the Act vest the responsibility of planning and development facilitation to the county government with collaboration with national government, this arrangement has been adopted for interventions

in order not to conflict with provisions of the Kenyan Constitution.

Relevance to the Project

The Project once commissioned shall be handed over to Limuru Water and Sanitation Company (LIWASCO) which is a water utility, wholly owned Kiambu County Government for operation and maintenance in accordance to the Act.

5.3.4 Physical Planning Act 1996 (286)

Section 29 of the said Act empowers the local Authorities (now county governments) to reserve and maintain all land planned for open spaces, parks, urban forests and green belts as well as land assigned for public social amenities.

The same section allows for prohibition or control of the use and development of an area. Section 30 states that any person who carries out development without development permission will be required to restore the land to its original condition. It also states that no other licensing authority shall grant license for commercial or industrial use or occupation of any building without a development permission granted by the respective local Authority.

Relevance to the Project

Thus the Act directs, regulates and harmonizes development and use of land over the Country, the entire pipeline route has been designed within the reserve land and Kenya Power way leave stipulated reserve land under this Act, this was in an effort to avoid cases of acquisition of private property and resettlement complications.

5.3.5 Occupational Health and Safety Act (OSHA 2007)

This legislation provides for protection of workers during construction and operation phases. It is tailored at implementation of the EHS plan in compliance with the relevant sections of this Act. The EMP prepared under this assessment has provided for specific health and safety aspects to be complied with during implementation of the project.

Relevance to the Project

The Act provides Occupational Health and Safety guidelines which shall be followed by both the contractor and supervising consultant during implementation of the Project in order to avoid injuries and even loss of life to workers and neighbouring community.

5.3.6 The Public Health Act (Cap.242)

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

injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 and include nuisances caused by accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

Relevance to the Project

The Act provides guideline to the contractor on how he shall manage all wastes (Liquid and Solid Wastes) emanating from the Project in a way not to cause nuisance to the community, this Act during construction shall be read alongside the waste management regulations of EMCA 1999 for utmost compliance. The Act also shall be applied to ensure that the food that is provided to the workers during construction of the Project meets the safety requirements.

5.3.7 Eviction Way leave and Rehabilitation Bill (2014)

Once passed by the parliament, it will be an Act of Parliament to provide for procedures for the evictions of unauthorized occupants from private or public land and the resettlement of displaced persons coerced or involuntary displacement and for matters incidental and related thereto.

The Bill main objective is to set out appropriate procedures applicable to evictions and resettlement, the bill also has outlined principles that are intended to guide the resettlement and eviction procedures including:

- Every person shall be protected from arbitrary eviction;
- the persons, affected by an eviction should not suffer detriment to their human rights;
- the Sate while carrying out eviction and resettlement, must observe the human dignity, equity, social justice, human rights, non discrimination and protection of the marginalized and vulnerable groups; and
- every person has the right to administrative action that is expeditious, efficient, reasonable and procedurally fair

Part (111) section (17) of the bill elaborates of the process to the undertaken when the government intends to evict persons from their land to create room for project, the bill gives power to the cabinet secretary based on the Environmental and Social Impact Assessment Report prepared, prepare a plan for the resettlement of the affected persons after consultation with the representatives of the affected persons.

Relevance to the Project

The Project route is entirely a government road reserve which implies that no person shall claim ownership of land for the pipeline to be constructed; the proposed sites for water treatment plant and sewerage treatment plant are located within government land.

The bill together with reference to Operation Safeguards (OS 2): Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation, World Bank OP 4.12 and KfW sustainability standards shall be used as reference during preparation and implementation of Project in case private assets and sources of livelihood are impacted.

5.4 Institutional Structure of the Water Sector

The National Policy on Water Resources Management and Development and the Water Act 2002, presently guides water resources management. The Water Bill 2014 will realign this arrangement slightly to comply with the requirements of the new constitution 2010

Therefore, the status quo remains as guided by the Water Act 2012. The overall goal of the national water development policy is to facilitate the provision of water in sufficient quantity and quality and within a reasonable distance to meet all competing uses in a sustainable, rational and economical way.

The Ministry of Environment, Water and Natural Resources is responsible for policy development, sector co-ordination, monitoring and supervision to ensure effective Water and Sewerage Services in the Country, sustainability of Water Resources and development of Water resources for irrigation, commercial, industrial, power generation and other uses. The Ministry executes its mandate through the following sector institutions:

5.4.1 Water Services Regulatory Board (WASREB)

The regulatory Board is responsible for the regulation of the water and sewerage services in partnership with the people of Kenya. The mandate of the regulator covers the following key areas:

- Regulating the provision of water and sewerage services including licensing, quality assurance, and issuance of guidelines for tariffs, prices and disputes resolution.
- Overseeing the implementation of policies and strategies relating to provision of water services licensing of Water Services Boards and approving their appointed Water Services Providers,
- Monitoring the performance of the Water Services Boards and Water Services Providers,
- Establish the procedure of customer complaints,
- Inform the public on the sector performance,
- Gives advice to the Minister in charge of water affairs.

5.4.2 Water Resources Management Authority (WRMA)

The authority is responsible for sustainable management of the Nations Water Resources:

- Implementation of policies and strategies relating to management of water resources, (ii) Develop principles, guidelines and procedures for the allocation of water,
- Development of Catchments level management strategies including appointment of catchments area advisory committees,
- Regulate and protect water resources quality from adverse impact
- Classify, monitor and allocate water resources.

5.4.3 Water Services Trust Fund (WSTF)

This body assists in the financing of the provision of Water Services to areas of Kenya which are without adequate water services. This shall include providing financing support to improved water services towards:

- Capital investment to community water schemes in underserved areas
- Capacity building activities and initiative among communities
- Water services activities outlined in the Water Services Strategic Plan as prioritized by the Government
- Awareness creation and information dissemination regarding community management of water services
- Active community participation in the management of water service

5.4.4 Water Services Boards (WSBs)

The WSBs are responsible for the efficient and economical provision of water and sewerage services in their areas of jurisdiction. Athi Water Service Board is among the seven catchment Boards established under the Water Act, 2002 and is mandated to:

- Develop the facilities, prepare business plans and performance targets
- Planning for efficient and economical provision of Water and sewerage services within their areas of jurisdiction;

The water services Board relevant to this Project is the Athi Water Services Board (AWSB)

5.4.5 Water Services Providers

Water Service Providers are the utilities or water companies. They are state owned but have been commercialized to improve performance and run like business within a context of efficiency, operational and financial autonomy, accountability and strategic, but minor investment. Relevant water services providers for the project is Limuru Water and Sewerage Company

5.5 NEMA Compliance

The government established the National Environmental Management Authority (NEMA) as the supreme regulatory and advisory bodies on environmental management in Kenya under EMCA 1999. NEMA is charged with the responsibility of coordinating and supervising the various environmental management activities being undertaken by other statutory organs. NEMA also ensures that environmental management is integrated into development policies, programmes, plans and projects.

5.6 Sectoral Integration

This integration encourages provision of sustainable development and a healthy environment to all Kenyans. The key functions of NEMA through the NEC include policy direction, setting national goals and objectives and determining policies and priorities for the protection of the environment, promotion of cooperation among public departments, local authorities, private sector, non- governmental organizations and such other organizations engaged in environmental protection programmes and performing such other functions as contained in the act.

Other stakeholder authorities include Ministry of Water Resources and Irrigation, Ministry of

Environment and Natural Resources, Ministry of Health and Sanitation, Ministry of Local Government, Ministry of Lands Housing and Urban Development, Ministry of Social and Cultural Services as well as the County Administration. Others are the Kiambu County Government and LIWASCO as well as key groups working with the beneficiary communities in the respective areas.

5.7 Project Implementation Institutional Structure

Athi Water Services Board has established implementation units for Project with Project engineers in charge for various county projects, the board hires on case by case basis the services of environment specialist to oversee implementation of the EMMSP developed for projects.

5.7.1 The Contractor

The contractor will be required to establish an environmental office to continuously advise on environmental components of the Project implementation. Elements in the environmental and social management plan are expected to be integrated in the Project with appropriate consultations with AWSB through the supervising environmental expert. The environmental officer of the contractor is also expected to fully understand the engineering and management aspects of the Project for effective coordination of relevant issues.

5.7.2 The Supervisor

The supervisor will be engaged by AWSB (as the Project proponent) to ensure effective implementation of the environmental management plan. It is expected that supervisor engages the services of an environmental expert who should in return understand the details of the recommendations on environment management and especially the proposed action plans, timeframes and expected targets of the management plan. The environmental supervisor expert should also be the liaison person between the contractor and AWSB on the implementation of environmental concerns as well as issues of social nature associated with the Project.

5.8 African Development Bank Polices on Environment Protection

The African Development Bank's environmental policy framework is strongly anchored in the concept of sustainable development. This concept defines sustainability as "development that meets the needs of the present without compromising the needs of the future".
The AfDBs Operational Safeguards (OS) include:

5.8.1 OS 1: Environmental and Social Assessment.

This OS governs the process of determining a project's environmental and social category and the resulting Environmental and Social Assessment requirements. The requirements cover the scope of application, categorization, use of Strategic Environmental and Social Assessment (SESA) and Environmental and Social Impact Assessment (ESIA) where appropriate, Environmental and Social Management Plans, climate-change vulnerability, public

consultation, community impacts, treatment of vulnerable groups, including indigenous peoples, and grievance procedures.

5.8.2 OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.

This OS consolidates Bank's policy on involuntary resettlement and incorporates a number of refinements designed to improve their operational effectiveness. In particular, the OS embraces comprehensive and forward-looking notions of livelihood and assets, to account for their social and cultural dimensions, as well as their economic ones. It also adopts a progressive understanding of community and common property that emphasizes the crucial need to maintain social cohesion, community structures and the social inter- linkages that common property provides.

5.8.3 OS 3: Biodiversity and Ecosystem Services.

This OS translates the policy commitments in the Bank's policy on integrated water resources management into operational requirements and also reflects the objectives of the Convention on Biological Diversity to preserve biological diversity and promote the sustainable use of natural resources. It reflects the importance of biodiversity in the African continent and the value to the population of key ecosystems. Its content has benefited from recent joint work among the MDBs to improve their approach to assessing how the potential impacts of projects on different types of habitats can be avoided, minimized or offset.

5.8.4 OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency.

This OS covers the range of key pollution, waste and hazardous materials impacts for which there are agreed international conventions as well as comprehensive industry-specific standards that are followed by financial institutions that have adopted the Equator Principles. It also introduces a GHG emission threshold for projects to trigger a detailed analysis of feasible reduction or offset measures and reporting on emission levels. Borrowers or clients are required to consider measures to improve resource efficiency.

5.8.5 OS 5: Labour Conditions, Health and Safety.

This OS aligns the Bank's requirements for its borrowers or clients with the range of International Labour Organization (ILO) conventions concerning workers' conditions, rights and protection from abuse or exploitation. It covers working conditions, workers' organizations, avoidance of child or forced labour and occupational health and safety.

Relevance

The Project is being financed by AfDB, was therefore checked against the above listed operation safeguards and appropriate mitigation measures of likely to be triggered under each policy was summarized in the EMSP and presented in **table 8** below

Table 8: Project Activities Triggering AfDB Operational Safeguards

Policy	Criteria in The Project	Discussions

OS 1: Environmental and Social Assessment.	Yes	The Project components will trigger EA safeguards and is Category B due to the interaction with the physical, biological and social setting within the immediate surroundings
OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.	Yes	The Project shall be constructed within existing public land, road reserves and river riparian, however, isolated cases on encroachment to public land was indentified which implies that RAP has to be prepared as part of this assessment. In some cases sections of private land shall be acquired along the pipeline route.
OS 3: Biodiversity and Ecosystem Services.	No	Project activities have no direct linkage to biological diversity and ecosystem services OS 1 shall be applied in isolated minor cases of biodiversity and ecosystem services.
OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency.	Yes	The Projects shall utilize raw materials both during construction and operation phase that could result to pollution of biophysical environment if not handled appropriately. Project activities shall not result to significant amount of green house gases, EMSP has proposed measures of ensuring that methane gas generated from the anaerobic ponds is collected and flared appropriately The Project design has ensured that the both clean water and sewer flows through the distribution lines by gravity hence reducing the need for pumping.
OS 5: Labour Conditions, Health and Safety.	yes	The Project shall involve workers both during construction and operation phases of the project. this policy read together with OSHA 2007 and IFC Performance Standards 2 on Labour and Working Conditions shall form integral instruments to be used in ensuring that health, safety and working conditions of both works and community is safeguards

5.9 Other International Environment Safeguards Instruments

5.9.1 Environmental Assessment OP 4.01

This policy requires Environmental Assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. The EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed investment. The EA process takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and cultural property) and trans boundary and global environmental aspects.

Operational Policy 4.01 further requires that the EA report must be disclosed as a separate and stand-alone document by the Government of Kenya and the World Bank. The disclosure should be both in Kenya where it can be accessed by the general public and local communities and at the InfoShop of the World Bank and the date for disclosure must precede the date for appraisal of the project.

5.9.2 Involuntary Resettlement (OP 4.12)

The objective of this policy to avoid where feasible, or minimize, exploring all viable alternative Project designs, to avoid resettlement. This policy is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts.

This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by (a) the involuntary taking of land resulting in (i) relocation or loss of shelter; (ii) loss of assets or access to assets, or (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Project appraisal of proposed projects. The objective of this policy to avoid where feasible, or minimize, exploring all viable alternative Project designs, to avoid resettlement. This policy is triggered when a Project activity causes the involuntary taking of land and other assets resulting in: Relocation or loss of shelter, loss of assets or access to assets, loss of income sources or means of livelihood, whether or not the affected persons must move to another location, loss of land

5.9.3 Bank Operational Policy 4.11-Physical Cultural Resources

The objective of this policy is to assist in preserving Physical Cultural Resources (PCR) and avoiding their destruction or damage. PCR includes archaeological, paleontological, architecturally significant, and religious sites including graveyards, burial sites, and sites of unique natural value.

Initial indications are that no observed physical or cultural resources will be affected by the project. Nevertheless, the Contractor is responsible for familiarizing themselves with the following “Chance Finds Procedures”, in case culturally valuable materials are uncovered during excavation, including:

1. Stop work immediately following the discovery of any materials with possible archeological, historical, paleontological, or other cultural value, announce findings to Project manager and notify relevant authorities;
2. Protect artifacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artifacts
3. Prevent and penalize any unauthorized access to the artifacts
4. Restart construction works only upon the authorization of the relevant authorities.

All contracts under this Project shall include a Chance Finds Procedure clause.

5.9.4 Bank Operational Policy OP/BP 4.04 (Natural Habitats)

The policy is designed to promote environmentally sustainable development by supporting the

protection, conservation, maintenance and rehabilitation of natural habitats and their functions. The policy seeks to ensure that World Bank-supported infrastructure and other development projects take into account the conservation of biodiversity, as well as the numerous environmental services and products which natural habitats provide to human society. The policy strictly limits the circumstances under which any Bank-supported Project can damage natural habitats (land and water area where most of the native plant and animal species are still present).

The Project will have limited direct interaction with riverine ecosystem due the nature of Project activities though appropriate management measures proposed in the assessment will need to be integrated to minimize any conflicts.

5.9.5 Bank Operational Policy OP/BP 4.36 (Forests)

The policy on forest safeguards seeks to realize the potential of forests to reduce poverty in sustainable manner, integrate forests effectively into sustainable economic development and protect the vital local and global environmental services and values of forests. Among the principles is to screen as early as possible for potential impacts on forest health and quality and on the rights and welfare of the people who depend on them.

The Project will have limited direct interaction with Ngong forest because the water pipeline is designed to be established within an existing power way leave within the forest. Though appropriate management measures proposed in the assessment will need to be integrated to minimize any conflicts.

5.9.6 World Bank OP/BP 4.10 (Indigenous Peoples)

This policy contributes to the Bank's mission of poverty and sustainable development by ensuring that the development process fully respects the dignity, human rights, economies and cultures of indigenous peoples. For all projects that are proposed for Bank financing and affect indigenous peoples, the Bank requires the borrower to engage in a process of free, prior, and informed consent.

The bank support of the Project by the affected Indigenous Peoples includes:

- Preventive measures to adverse effects to the indigenous cultures and practices,
- Avoid potential adverse effects on the Indigenous Peoples' communities;
- When avoidance is not feasible, minimize, mitigate, or compensate for such effects.

Bank-financed projects are also designed to ensure that the Indigenous peoples receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive.

The objective of this policy is to design and implement projects in a way that fosters full respect for Indigenous Peoples' dignity human rights and cultural uniqueness and so that they receive culturally compatible social and economic benefits and do not suffer adverse effects during

the development process. This safeguard is not triggered in this project.

5.9.7 Banks Operational Policy OP/BP 4.09 (Pests Control Management)

The policy is meant to minimize and manage the environmental and health risks associated with pesticides use and promote and support safe, effective and environmentally sound pest management. The safeguard is not triggered under this Project. **Table 9** shows Project activities triggering World Bank safeguards. The schedule below justifies the extent to which the World Bank safeguards apply to the implementation of the proposed Project implementation.

Table 9: Project Activities Triggering World Bank Safeguards

Policy	Criteria in The Project	Discussions
Environmental Assessment (OP4.01, BP4.01, GP	Yes	The Project components will trigger EA safeguards and is Category B due to the interaction with the physical, biological and social setting within the immediate surroundings
Forestry (OP4.36, GP4.36)	No	The project is to be implemented within human settled environment
OP/BP 4.04 (Natural Habitats)	No	Project activities have no direct linkage to riverine ecosystem, within the forest as no habitat shall be interfered.
Involuntary Resettlement (OP4.12,BP4.12)	Yes	The proposed pipeline corridor is clear of encroachment, however isolated cases of temporal structures were indentified in the town, these shall be addressed in the RAP assessment
Physical Cultural Resources(OP/BP4.11)	yes	No cultural features however 'chance find clause' will be applied
Indigenous Peoples Policy OP/BP4.10	No	No indigenous peoples
OP/BP 4.09 (Pests Control Management)	No	No linkage to agricultural activities

5.9.8 KfW Sustainability Guidelines 2014

The Guidelines were developed in April 2014 to provide a framework for ensuring environmental and social policies that govern KfW's operations are included in Project design in order to achieve sustainable development within the meaning of the German Federal Government's sustainability strategy.

The Guidelines describes principles and procedures to assess the environmental, social and climate impacts during the preparation and implementation of measures financed by KfW Development Bank. In this context, the Guideline pursues the following objectives, in particular:

- Define a common binding framework to incorporate environmental, social and climate standards into the planning, appraisal, implementation and monitoring of measures financed by KfW Development Bank;
- To promote transparency, predictability and accountability in the decision-making processes of environmental and social impact assessments (ESIA) and climate change assessments.

- To improve the assessment of economic risks associated with projects by taking account of the environmental, climate and social aspects.

Section 4 of the Guidelines provide the process of undertaking environmental and social impact assessment as well as core objectives which is to anticipate and appraise any foreseeable impact a Project may have on the environment, the climate and/or on social factors (including human rights), and to identify and prevent any negative impact, or limit it to a tolerable level and (provided that the negative impact is inevitable but still tolerable) introduce compensation measures. In addition, the assessments should identify, monitor and manage any residual risks.

Section 4.2 provides of Screening and classification of projects just the World Bank Operation Policies; all projects are required to be classified into one of the following three categories A, B or C, according to the relevance of their potentially negative environmental and social impact. Limuru Sewerage Project has been classified as category B

Section 4.4 of the Guidelines provides for KfW Appraisal standards of development projects which require environmental, social and climate compatibility of its projects are met prior to financing, KfW Development. The bank takes into account the Sustainability Guidelines of KfW Group, the specific development policy concepts and guidelines for development cooperation issued by the German Federal Government, and other international safeguards and standards for the environmental, climate and social sustainability of development projects. With a view to achieving sustainability and preventing negative environmental, climate and social consequences, KfW Development Bank has to ensure that all projects funded by the bank comply with the principles of sustainable financing.

This assessment has been prepared in order to ensure that following KfW sustainability principles which can be referenced to International Finance Cooperation (IFC) Performance Standards, the principles are;

- The principle of preventing, reducing or limiting environmental pollution or degradation, including greenhouse gas emissions and other burdens.
- The principle of protecting and preserving biodiversity and tropical forests and managing natural resources in a sustainable manner.
- The principle of consideration of probable and foreseeable consequences of climate change.
- The principles of avoiding any adverse impact on community life, particularly of indigenous people and other vulnerable communities, and safeguarding the rights, living conditions and values of indigenous communities.
- The principles of avoiding or minimising involuntary resettlement and forced eviction of communities and mitigating the negative social and economic consequences arising from changes in the use of land and soil by restoring the original living conditions of the communities concerned;
- The principles of promoting health and safety at work and industrial safety for all Project staff.
- The principles of outlawing forced labour and the worst forms of child labour, banning discrimination in professional life and at the workplace and promoting the freedom of association and the right to collective bargaining;
- The principles of protecting and preserving cultural heritage;

- The principles of assisting the executing agency in managing and monitoring potentially negative environmental, climate and social consequences arising from the implemented project.

Relevance to the Study

The assessment has been prepared also to comply with such other international standards of the World Bank Group (Environmental, Health and Safety Guidelines (EHS) International Bank for Reconstruction Development (IBRD) and International Development Agencies (IDA) Safeguard Policies and IFC Performance Standards) and other equivalent standards issued by regional development banks or by the EU, this is also recognized by KfW.

5.10 Relevant International Conventions

Methane gas is an output of the Feacal Sludge Treatment Plant and is also one of the major ozone depleting substances. The following international conventions will be relevant to the Project as they are concerned with the protection of the ozone layer

5.10.1 The 1985 Vienna Convention for the protection of the Ozone Layer

The Vienna Convention for the Protection of the Ozone Layer, 1985 was adopted after consensus was reached on 22nd March 1985. The overall objective of the Vienna Convention is to protect human health and the environment against the effects of ozone depletion which result from Green house gases.

5.10.2 The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol on Substances that Deplete the Ozone Layer is a significant milestone in international environmental law. It establishes firm targets for reducing and eventually eliminating consumption and production of a range of ozone depleting substances. These substances are enumerated in Annexes A-E to the Protocol and are to be phased out within the schedule given in article 2A-2I.

5.10.3 The United Nations Convention on Climate Change ("1992 UNFCCC")

The objective of the 1992 UNFCCC is to tackle the negative effects of climate change. The Conventions' stated aim is to stabilize greenhouse gas concentrations at a level that allows ecosystems to adapt naturally to climate change so that food production is not threatened, while enabling economic development to proceed in a sustainable manner (article 2).

5.10.4 The Kyoto Protocol

The Kyoto Protocol was adopted in December 1997 at the Third Conference of the Parties held in Kyoto. The Kyoto Protocol requires stronger commitments from parties to achieve quantified emission reductions within a specific timeframe. These commitments cover the six greenhouse gases listed in Annex A of the Kyoto Protocol (Carbon dioxide, Methane, Nitrous oxide, Hydrochlorocarbons, Perfluorocarbons and Sulphur hexafluoride).

Relevance

Athi Water Services Board and the contractor will be required to carry out regular inspection and maintenance of construction equipment in order to reduce the levels of green house gas emissions into the atmosphere, the design of the sewer ponds should ensure that the

anaerobic ponds are covered to trap the methane gas which should be cleaned and used appropriately as renewable energy.

CHAPTER 6: STAKEHOLDER CONSULTATION

6.1 Stakeholder Consultations

Stakeholder consultation is useful for gathering environmental data, understanding likely impacts, determining community and individual preferences, selecting Project alternatives and designing viable and sustainable mitigation and compensation plans.

Stakeholder consultation in the EIA process is undertaken during the Project design, implementation and initial operation. The aim is to disseminate information to interested and affected parties (stakeholders), solicit their views and consult on sensitive issues.

Inadequate public consultation can result in significant information gaps, which could mislead environmental planners undertaking an environmental assessment. Lack of attention to communication and consultation processes can generate individual, community, or regional opposition to a project. This can ultimately be a cause of substantial delays, increased costs, and unsatisfactory compromise solutions, which could have been avoided through earlier consultations. Participation is therefore a process through which different stakeholders influence and share their views regarding development initiatives and the decisions and resources that affect them.

6.1.1 Stakeholder Mapping

The aim of this will be to ensure that all the stakeholders likely to be affected or influence the Project are identified and targeted as part of the ESIA study. The following stakeholders are necessary and require to be engaged in the ESIA study, they include;-

- County Government in Project Area e.g. County Executive Community Members in County traversed by Project for water, Social, environment and land affairs
- Project Affected Persons
- Ministry of Lands
- National Land Commission
- County Administration-County Commissioners, Deputy County Commissioners Assistant County Commissioners, Chiefs and Assistant Chiefs, Village elders etc.

The **table 10** below indicates a detailed stakeholder indentified and consulted during the assessment

Table 10: Relevant Stakeholders

Name	Category
Athi Water Services Board (AWSB)	Project proponent
Population in Waste Water Treatment Sites and pipelines,	Project beneficiaries and Affected Persons
Kiambu County officials	County Government
Members of County Assembly	
County Commissioner representatives	National Government Administration
Deputy County Commissioners representative	
Representative of the legislature	National Legislature
Water Resources Management Authority (WRMA)	Water Regulatory Body

Limuru Water and Sanitation Company	Project beneficiaries
Water Users Association	Water Users of Associations of effluent receiving rives
Sub-County Water Officer	National Government Line Ministries
Physical Planning Office	
Public Health Officers	
NEMA County Officer in Kiambu County	
Sub-county Lands Officer;	
Sub-County Development Officer (DDO);	

6.1.2 Stakeholder Consultation Methods

The assessment involved consultations with relevant stakeholders in Limuru town. The aim of stakeholder consultations was to give a platform for information sharing and opinion gathering in relation to the proposed project; consultations were done in form of public meetings and key informant interviews. The issues were than analyzed and presented to design team for finalization of Project designs and planning on how best to implement the Project. The main meeting was held within September 2015 and June 2016 at Limuru Town attendance of the meetings was from diverse sectors of the society.

6.1.3 Key Informants

During the scoping stage several consultations were conducted including Key Informant Interviews/ meetings held with various Kiambu County government officers, Town Planning Team (TPT) representatives as well as the Multi-stakeholder Forum (MSF) representatives from September 2015 to June 2016. During this stage of the study, Key informant interviews were conducted with Specific County, Sub- County Government representatives of National Line ministries and Multi Stakeholder. **Table 11** below presents a schedule of the meetings held in the project area.

Table 11: Schedule of meetings

Meeting	Venue	Date	Participation
Key Informant Meeting	LIWASCO	21st September 2015	LIWASCO Officials
Stakeholders meeting	Limuru town	23rd September 2015	County Government officials LIWASCO staff, WRMA, Local Administration officials, open public

Figure 25: Public Participation Meetings

Images of Key Informant Consultations

Images of Key Informant Consultations

6.1.4 Summary of issues raised in consultations during the assessment

The key findings during public consultations during the scoping/ Project report phase are presented in **table 12** below.

Table 12: Summary of Outcomes of Consultative Meetings

Issues	Response and Discussions
Residents wanted to know the expected commencement date for the project.	EIA team responded that the project will commence immediately after all the preliminary surveys and consultations have been finalized. It is expected that the project will commence early next year depending on availability of funds.
Residents raised the issue of Adour from the sewerage plant they were concerned that expanding it to hold more sewer will also lead to more adour and wanted to know how the smell will be mitigated.	EIA team responded and informed the residents that the design will adopt modern technology that will ensure the ponds function efficiently leading to reduction in the adour. The engineer can also adopt a conventional method that increases oxygen supply to the pond and also plant trees like bamboo on the windward side to break the wind that carries the adour.
The community wanted to how the land to construct the trunk sewer line will be acquired since Limuru is a densely populated area making land an expensive and sensitive issue.	The EIA team informed Limuru residents that the current design indicates that the trunks will be constructed in road reserves and the river riparian to limit issues of displacement of people. The administration requested to be informed earlier enough before the contractor mobilizes on the ground so that encroachers can be given amble time to vacate.
Residents wanted to know the exact places the trunk sewer will be constructed and also areas that will be given lateral lines for connection to the main trunk sewer	EIA team informed the residents that from the preliminary design indicated that the main trunk sewer will run along River Githanje the laterals to be constructed on a need basis. Residents suggested the following areas to be given first priority.
Residents wanted to know if the numerous small factories will be allowed to connect to the main sewer trunk since they were notorious for polluting the rivers in Limuru	The EIA team informed the area residents that it was a requirement for factories to pre-treat their waste before releasing it to the main sewer line, the same also applies to hospitals.

Issues	Response and Discussions
Residents wanted to know if the contractor will source workforce from the area residents during construction of the sewer line.	The EIA team informed residents that during construction the contractor will source some responsible youth from the area for casual employment to supplement his permanent staff. Residents with relevant skills and training can also present their certificates to be considered for employment opportunities if need arises. Some small contractors within Limuru asked to give sub-contracts where possible.

6.1.5 Consultations beyond ESIA Process

In order to ensure that the development runs smoothly, consultations should be structured to aid the completion of the Design and narrow down on key issues. These consultations should therefore be preceded by further engagement of various stakeholders under the following stages:

- Construction phase and reported through the Initial Environmental Audit; and
- Operation phases and reported through the Statutory Environmental Audit of the Project.

The consultation should address pertinent issues including the sustainability and suitability of the operation and maintenance to ensure acceptable standards in both Water and Sanitation Project

CHAPTER 7: ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT & MITIGATION

7.1 Introduction

This ESIA assessment has been systematically conducted to determine whether the proposed Project will have a diverse impact on the environment. The Environmental Management and Co-ordination Act (EMCA) No.8 of 1999 provide the legal and statutory guideline for the Environment and Social Impact Assessment process in Kenya.

The impacts in this chapter have been generated based on the analysis of the proposed environment in relation to the proposed project. The impacts arising during each of the phases of the proposed development namely construction, operation and decommissioning, can be categorized into:

- Impacts on biophysical environment;
- Health and safety impacts; and
- Social-economic impacts

7.2 Definition and Classification of Environment Impact

An environmental impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts may be:

- Positive (beneficial) or negative (adverse);
- Direct or indirect, long-term or short-term in duration, and wide-spread or local in the extent of their effect.

Impacts are termed cumulative when they add incrementally to existing impacts. In the case of the project, potential environmental impacts would arise during the construction and the operations phases of the Project and at both stages positive and negative impacts would occur.

7.2.1 Impact Significance

The purpose of this ESIA report is to identify the significant impacts related to the Project or activity under consideration and then to determine the appropriate means to avoid or mitigate those which are negative. Significant impacts are defined, not necessarily in order of importance, as being those which:

- Are subject to legislative control;
- Relate to protected areas or to historically and culturally important areas;
- Are of public concern and importance;
- Are determined as such by technically competent specialists;
- Trigger subsequent secondary impacts;

- Elevate the risk to life threatening circumstances; and
- Affect sensitive environmental factors and parameters

7.2.2 Impact Assessment and Scoring

The potential impacts associated with the proposed development have been assessed as presented in the **table 13** below. Precautionary principle was used to establish the significance of impacts and their management and mitigation i.e. where there is uncertainty or insufficient information, the Environmentalist erred on the side of caution.

Table 13: Environment Impact Scoring and Rating Criteria

Severity of Impact	**Rating**	**Scoring**
Insignificant / non harmful/less beneficial	-1/+1	Very Low
Small/ Potentially harmful / Potentially beneficial	-2/+2	Low
Significant / slightly harmful / significantly beneficial	-3/+3	Medium
Great/ harmful / beneficial	-4/+4	High
Disastrous/ extremely harmful / extremely beneficial	-5/+5	Very high
Spatial Scope of the Impact	**Rating**	**Scoring**
Activity specific	-1/+1	Very Low
Right of way specific	-2/+2	Low
Within Project area 5km radius	-3/+3	Medium
Regional	-4/+4	High
National	-5/+5	Very high
Duration of Impact	**Rating**	**Scoring**
one day to one month	-1/+1	Very Low
one month to one years	-2/+2	Low
Within Project construction period	-3/+3	Medium
within the Project life	-4/+4	High
at decommissioning	-5/+5	Very high

Example of Cumulative Impact Scoring

1. +3,+2,+5,+4, +4,+1=+4 (the weight that occurs more is adopted)
2. +2,+2,+5,+4, +4,+1=+3 (if two scores or more tie, then an average of the scores shall be adopted)

7.3 Positive Impacts during construction phase

The Project construction phase normally includes Pre Construction Phase and Construction Phase, construction period depends on the nature of the project activities and normally vary from one year to three years, sub sections 7.3.1 to 7.3.4 below presents anticipated positive Project impacts and their impact rating.

7.3.1 Employment Opportunities

The project construction phase will result to employment opportunities for both professionals and unskilled workers, earnings from the wages will improve their living standards. The workers will include casual Labourers, Plumbers and Engineers are expected to work on the site for a period of

time. Semi skilled, unskilled labourers and formal employees are expected to obtain gainful employment during the period of construction. With labour intensive construction technologies, the Project will provide employment for youths and provide support to the Government of Kenya initiatives on creation of jobs

Impact Scoring

Severity of Impact	+4
Spatial Scope of the Impact	+5
Duration of Impact	+4
Overall score	**+4**
Interpretation	**High**

7.3.2 Market for Construction Materials

The Project will require materials, some of which will be sourced locally and some internationally. These include plant (pump sets, switch gear, instrumentation and surge protection systems) steel and plastic pipes, valves, cement, sand, hardcore and chemicals. This will provide a ready market for suppliers in and outside the Project area.

Impact Scoring

Severity of Impact	+4
Spatial Scope of the Impact	+3
Duration of Impact	+4
Overall score	**+4**
Interpretation	**High**

7.3.3 Injection of Money to the Local Economy

A large sum of the Project money will be released into the local economy due to the construction activities. It is envisaged that during construction a large number of downstream activities shall take place including but not limited to the following listed below, It is estimated that at least 30% of the Project funds shall be used up directly within the Project area.

- Payments for skilled and unskilled labour;
- Purchases of construction materials; and
- Payments for local provisions including fuel, foods and accommodation

Impact Scoring

Severity of Impact	+4
Spatial Scope of the Impact	+5
Duration of Impact	+4
Overall score	**+4**
Interpretation	**High**

7.3.4 Creation of Wealth

The proposed development brings many opportunities in investment and procurement where the youth and people of Limuru town can compete to provide different goods and services to the proponent during construction of the sewer pipelines. This in turn creates opportunities for entrepreneurship and wealth creation for the youth in the town

The construction phase will attract temporary business such as food vendors who will benefit from the trade by selling the food to the construction workers. This will improve their living standards from their earnings.

Impact Scoring

Severity of Impact	+3
Spatial Scope of the Impact	+5
Duration of Impact	+4
Overall score	**+4**
Interpretation	**High**

7.4 Negative Impacts during Construction Phase

The Project Construction Phase shall involve the following activities:

- Delivery of Construction Equipment and Materials to the Project Site including Contractor's Equipment, Pipes and Fittings, etc.
- Site Clearance and Excavation activities;
- Temporary stockpiling of soils, sub-soils and rock along the trenches;
- Construction Works including Pipe Laying, Road Crossings, Pipe Testing, etc.
- Ground Reinstatement

For purpose of assessment of the negative impacts the project components were divided into two categories which are likely to pose different environmental characteristics. The components are as shown in **Table 10** below:

Table 10: Project Components

Project Component	Description
Component 1	Sewer Pipelines and associated works
Component 2	Waste Water Treatment Plant works

The potential negative impacts are assessed in the sections that follow.

7.4.1 Resettlement Impacts

Acquisition of easement for lying the sewer pipelines and land for setting up the sewerage treatment plant was considered as the main factor in indentifying sewerage pipeline route and site for the sewer treatment plant. The following measures were adopted to minimize project impact to private assets and sources of livelihood and the need for land acquisition and resettlement

impacts, the measures include.

- Trunk sewer, secondary sewers are planned to be located within existing way-leaves and riparian land
- The choice of Waste Water Treatment Technology selected is Oxidation ditches which do not require large parcel of land and be constructed within the existing land

Photo Plate 2: Proposed Sewer Routes

	
Sewer route along Kwambira - Limuru Road	Sewer Route along Bata Shoe Company Storm Water Drain in Limuru Town

RAP Assessment Findings

The RAP assessment for the proposed project investment indentified the following

Box 4: Resettlement Impacts

- No private land will be acquired to establish the project under both component 1 and 2 described above
- The sewer lines have been designed to follow existing road reserve
- RAP indentified approximately 20PAPs who are likely to be affected by the project along Limuru town to sewer ponds line
- The project impacts on limited to temporal disruption of business during project construction phase to people near the Bata shoe company
- The type of structures likely to be affected are temporal and mobile structures along the sewer line

Provision of African Development Bank Safeguard Policy on Land Acquisition and Involuntary Resettlement (OS 2) will be the main framework that will be adopted in preparing RAP document for the project. Referring to African Development Bank (AfDB) operational safeguards policy on land acquisition and involuntary resettlement, a Resettlement Action Plan (RAP) for affected persons has been prepared as a separate report to this study.

Impact Scoring

Severity of Impact	-3
Spatial Scope of the Impact	-2
Duration of Impact	-3
Overall score	**-3**

Interpretation	**Medium**

Mitigation measures

- Prepare a Resettlement Action Plan (RAP) for purposes of compensation of likely assets and sources of livelihood for Project affected persons.

7.4.2 Vegetation Clearing, Soil Erosion and Sedimentation

Construction activities have the potential to clear vegetation and, loosen soils particularly on slopes which can then be washed down into the lower areas (streams and valleys) and soil quality degradation is also likely to occur during construction as a result of disposal of construction materials on the adjacent lands especially near the base of the valleys and ultimately into the rivers. This impact is low to both components of the project.

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-2
Duration of Impact	-3
Overall score	**-2**
Interpretation	**low**

Mitigation measures

The following are proposed to mitigate against soil erosion and, its effects and enhance vegetation cover.

- Re-plant the indigenous vegetation as much as practical once work is completed.
- Limit vegetation clearance unless where unavoidable circumstances appear;
- Contain excavated soils so that they will not find their way into nearby water sources;
- Cement mixing should be done in a designated area away at a safe distance from storm water drains;
- Spilled cement or concrete should be collected and disposed away from natural water ways or storm water drainage;
- Sensitise workers and enable them to properly handle concrete spillages or waste cement;
- Re-vegetation of exposed areas around the site should be carried out rapidly in order to mitigate against erosion of soil through surface water runoff and wind erosion.

7.4.3 Air Quality Pollution

Potential air pollution caused by dust and emissions from construction equipment (carbon, hydrocarbons, particulate matter,) earth movers and excavators, vehicles, concrete and cement batching plants and trucks, Emission of dust from trucks and vehicles accessing the construction areas and camp sites as well as material piling (sand and aggregate). Odor from temporary disruption of accumulated solid waste materials at locations of construction and connections to existing sewerage network, such impacts may affect the immediate residential houses and commercial premises. This impact is likely to be more under component 1 of the project where the contractor will be working near people's homes that under component 2 of the works where the contractor will be working within the existing waste water treatment ponds. The impact is rated

low to both components of the project.

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-2
Duration of Impact	-3
Overall score	**-2**
Interpretation	**low**

Mitigation Measures

- Maintain construction equipment at high operational conditions such as to control emissions into the air.
- Earth moving be done under dump conditions as much as possible to prevent emission of dust into the air,
- Similarly, piled materials (sand and aggregate) should be maintained dump to prevent dust emissions,
- It will be necessary to notify the immediate neighbourhoods on the potential odors during the excavations. The period should, however, be kept as short as possible (odor generation may not be fully eliminated during the period)
- Use of sprinklers to regularly water construction site, this suppresses the dust menace at construction sites

7.4.4 Excessive Vibration and Noise Pollution

Construction Phase for the proposed Project will most likely result in noise emissions as a result of the machines that will be used (excavation equipment among others) and construction vehicles delivering materials to site. Noise and excessive vibration can be a nuisance to the local community if construction works begin too early in the day and continues into the night. This impact is rated medium under both components of the project. the impact is rated medium to both components of the project.

Impact Scoring

Severity of Impact	-3
Spatial Scope of the Impact	-1
Duration of Impact	-3
Overall score	**-3**
Interpretation	**Medium**

Mitigation measures

To control noise pollution:

- Avoid night time construction when noise is loudest;
- Conduct periodic noise measuring and monitoring to determine levels and extent of harmful noise, the required decibel levels is 60dbl
- Clearly label the high noise areas;
- Provide PPE (hearing protection) to persons operating within or visit identified high noise

areas;

- In order to meet noise level requirements, the equipments should be equipped with standard noise attenuation features. Machines that exceed acceptable noise limits should be equipped with silencers or lagging materials or specially designed acoustic enclosures;
- Inform local residents when construction activities are likely to generate excessive noise in order to minimize disruption to local residents;
- Sensitize truck drivers to avoid hooting especially when passing through sensitive areas such as churches, residential areas and hospitals

7.4.5 Water Quality Pollution

Limited discharge of silt into rivers and other local drainage system from earth moving during construction, Potential discharge of oil residuals into the same rivers and open rains from the construction equipment and disruption of accumulated solid wastes from work areas and washed down into the river and other drains,

Organic and Nutrients loading of the drainage channels is likely to occur due to accumulation of wastes within construction sites and leakages of raw sewerage to drainage channels resulting to increase of nutrient levels with water bodies in the area, indentified water resources likely to be affected include artificial wetlands. The impact is rated medium to both components of the project.

Photo Plate 3: Wetland receiving Effluent from Sewer Treatment Plant

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-3
Duration of Impact	-3
Overall score	**-3**
Interpretation	**Medium**

Mitigation Measures

- Containment of waste water from construction activities
- Isolate solid wastes disrupted from the works during excavations for safe disposal. The wastes should be collected and disposed in approved sites.
- Earth moving and excavations for the construction are carried out considering safety of the river and surface drainage. Control siltation of rivers and other surface drains

- Ensure spilt oil does not discharge into water sources Provide oil spill containment including concrete platform for servicing of construction equipment and holding of scrap oil drums.

7.4.6 Drainage and Hydrology Disruption

Project construction will involve earthworks and excavation that could interfere with local drainage in Limuru towns with a potential to divert the normal surface drains towards homes and private plots. No significant implications are expected in the general hydrology of the larger project area.

Earthworks activities will result in the generation of some spoil materials. When not handled properly the soils could lead to sedimentation of the nearby water sources which will interfere with the habitats and hence flora and fauna downstream of such rivers within the Project area. The impact is rated low to both components of the project

Photo Plate 4: Existing Drainage Channels

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-2
Duration of Impact	-3
Overall score	**-2**
Interpretation	**Low**

Mitigation Measures

- Excavated channels to follow contours to avoid interference with surface drains;
- Whenever necessary, drains along the construction line are directed towards existing drainage systems to cater for storm water during the rains. However, construction should be carried out during a dry season and should take the shortest period possible;
- Utilise excavated soil to level excavated ground where necessary and cover the water and sewer lines that will have been laid in the ground;
- Construction materials and other debris (lime, cement and fresh concrete.) should be handled carefully to prevent them from finding their way into the nearby water sources
- Ensure compliance with environmental laws.

7.4.7 Interference with the Physical Setting

The proposed Project could result into the following negative impacts to the physical setting:

- Blockage of natural drainage system at valley crossings;
- Excavation for creation of access routes and related structures.

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-2
Duration of Impact	-3
Overall score	**-2**
Interpretation	**low**

Mitigation measures

- The structures to be developed should be aesthetically acceptable to blend in with the surrounding;
- The proponent shall as much as possible complete the works in such a way that natural aesthetics shall be retained at the locations. Restoration shall be undertaken to ensure that the original setting is as much as possible retained.

7.4.8 Interruption of Existing Infrastructure

There are various installations that will be crossed, move in or move along installations among them

- Roads both main roads and feeder roads in the towns and estates
- Underground utilities e.g. electricity and water lines with the estates
- Fences and temporal structures along the main roads
- Railway line at Bata shoe factory

These services are critical and have implications with spillover effects on the social and economic performance.

Impact Scoring

Severity of Impact	-4
Spatial Scope of the Impact	-3
Duration of Impact	-3
Overall score	**-3**
Interpretation	**Medium**

Mitigation measures

- Formal request for permission to cross, break in and lay the pipelines should be sought from affected property owners which include Kenya Railway, Kenya Rural Roads Authority, Kenya Power, Limuru Water and Sewerage Company and Kiambu County.
- A work plan with clear responsibilities for each party should be developed to ensure smooth execution of the construction.

7.4.9 Extraction and Use of Construction Materials

Construction materials that will be used in the construction such as hard core, cement and rough stone will be obtained from quarries, hardware shops and sand harvesters who extract such materials from natural resource banks such as rivers and land that are supposed to be regulated to

enable for their natural regeneration.

Impact Scoring

Severity of Impact	-1
Spatial Scope of the Impact	-1
Duration of Impact	-3
Overall score	**-3**
Interpretation	**Very Low**

Mitigation measures

- The materials shall be sought from licensed suppliers and licensed quarry sites by NEMA. This will allow for protection of quarry sites to be used within their natural regenerative capacity.

7.4.10 Solid Waste Generation

Solid wastes generated during construction include papers used for packing, plastics, cuttings and trimmings off materials among others. Dumping around the site will interfere with the aesthetic status on the surrounding environment. Plastic bags may act as pest breeding grounds which may be disease causing vectors to the local residents. This impact is medium to all the project components.

Impact Scoring

Severity of Impact	-3
Spatial Scope of the Impact	-2
Duration of Impact	-3
Overall score	**-3**
Interpretation	**Medium**

Mitigation measures

- A site waste management plan should be prepared by the contractor prior to commencement of construction works. This should include designation of appropriate waste storage areas, collection and removal schedule and identification of approved disposal site;
- Proper solid waste receptacles and storage containers should be provided, particularly for the disposal of lunch and drink boxes so as to prevent littering of the site.
- Arrangements should be made for the regular collection of litter and for its disposal with the County Government
- Ensure that the solid waste collection, segregation, and disposal system is functioning properly at all times during the construction phase;
- Recycle and re-use wastes where possible such as scraps metal.

7.4.11 Occupational Health and Safety Risks

Potential impacts during construction include: exposure to physical hazards from the use of equipments; trips and fall hazards; rock falls/slides in steep areas and exposure to dust and noise. Construction workers are likely to have injuries and hazards as the construction works such as

trenching and excavations so as to lay sewer pipelines unavoidably expose workers to occupational health and safety risks. The workers are also likely to be exposed to risk of construction noise and air pollution.

Impact Scoring

Severity of Impact	-3
Spatial Scope of the Impact	-2
Duration of Impact	-3
Overall score	**-3**
Interpretation	**medium**

Mitigation measures

- Ensure that all construction machines and equipment are in good working conditions to prevent occupational hazards during excavation activities and laying of the pipes;
- Establish a Health and Safety Plan (HASP) for civil works areas ensuring the working hours are controlled and that employees are not allowed to extend the working hours beyond an acceptable limit for purposes of gaining extra pay;
- Provide adequate manual labour to meet the requirements of the tasks;
- Appoint a trained health and safety team for the duration of the construction work ,monitor and advise appropriately on health and safety matters during the rehabilitation activities
- Provide workers with gloves, ear gears, sturdy rubber boots and overalls to protect their skin from the effects of cement;
- Provide workers training on safety procedures and emergency response such as fire and sewer pipe bursts;

7.4.12 Spread of Communicable Diseases and HIV/AIDS Infection

The Project will attract new people to the Project area and this can lead to several repercussions leading to the spread of HIV/AIDS and/ or other sexually transmitted diseases (STDs). Influx of new people to the Project area especially construction workers can affect the number of new cases of HIV, because they often interfere with an otherwise stable situation but the contrary can also happen where the newcomers find themselves at higher risk.

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-3
Duration of Impact	-3
Overall score	**-3**
Interpretation	**Medium**

Mitigation Measures

Develop HIV/AIDS awareness programmes or initiatives to target the construction workers both from the Project site and beyond, institutional communities and the general members of the community, particularly the youth; with the objective of reducing the risks of exposure and the spread of HIV virus in the Project area. Measures recommended for implementation to enable reduce the spread of the virus include the following;

- Review the construction activities to integrate with the HIV/AIDS campaigns;
- Develop appropriate training and awareness materials for Information, Education and
- Communication (IEC) on HIV/AIDS;
- Identify other players (local CBOs, NGOs, and government organizations) on
- HIV/AIDS for enhanced collaboration;
- Develop an intervention strategy compatible with the construction programme to address success of the HIV/AIDS prevention and provide peer educators for sustainability in collaboration with other stakeholders; and
- Integrate monitoring of HIV/AIDS preventive activities as part of the construction supervision. Basic knowledge, attitude and practices are among the parameters to be monitored, and particularly on provision of condoms, status testing and use of ARVs

7.5 Positive Impacts during Operational Phase

The project main objective is to improve the quality of life of people within Limuru through provision of improved Water Services. Sub Section 7.5.1 to 7.5.3 illustrates the main direct benefits of the project once commissioned.

7.5.1 Improved Sanitation within Limuru town

As described in Kenya's development Blue Print (Vision 2030), Kenya's transformation in to a middle income country will be achieved by bringing and improving basic infrastructure and services namely: roads, street lights, storm water drains, footpaths, and water and sanitation facilities among others. This Project aims at improving the sanitation services in Limuru town and environs through the project.

The sanitation component of the Project will improve the sanitation status in towns. Providing basic sanitation through improved sewer network coverage together with hygiene education may bring about a major reduction of water-related health risks and child morbidity and mortality as described in the MDG no. 4.

Impact Scoring

Severity of Impact	+5
Spatial Scope of the Impact	+3
Duration of Impact	+4
Overall score	**+4**
Interpretation	**High**

7.5.2 Creation of Job Opportunities

Construction of the Project will trigger extension of services to the residents of Limuru town. The Project is likely to increase the work schedules within LIWASCO therefore attracting employment opportunities for extra duties. This in turn will improve the living standards of the residents in Limuru through employment opportunities that may emanate from the investments.

Impact Scoring

Severity of Impact	+3

Spatial Scope of the Impact	+1
Duration of Impact	+4
Overall score	**+4**
Interpretation	**High**

7.6 Negative Impacts during Operation Phase

The project operation phase will have potential negative impacts, this impacts are less significant and can be easily be mitigated as described in sub sections 7.6.1 to 7.6.6 below.

7.6.1 Negative Impacts Associated with Sewer Lines

i. Health and Hygiene risks associated with Sewerage Contamination

Poorly maintained and designed sewers can lead to dispersal of raw sewage particularly at manholes and burst areas into the environment. These can cause outbreaks of water borne related diseases like cholera and typhoid from contamination of water sources by raw sewage.

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-3
Duration of Impact	-4
Overall score	**-3**
Interpretation	**Moderate**

Mitigation measures

- Ensure proper and periodic maintenance of sewer lines and treatment plant;
- Activate a community watch group for information sharing on the status of the sewer line
- Regular check, repair and maintenance of the sewer line
- Awareness rising among community members not to dump solids in manholes.
- Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups
- Development of an inventory of system components, with information including age, construction materials, and drainage areas served elevations.
- Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize entry of garbage and silt into the system
- Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulphide generation

ii. Risks of Illegal Connections to the Sewer lines

The is common in the low income areas where residents connect to sewerlines illegally to avoid paying the connection fee and monthly service charge, this vice leads to loss of revenue to the WSP and also if condoned eventually lead to overloaded system. Impact rating to this risk is illustrated below

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-1

Duration of Impact	-4
Overall score	**-2**
Interpretation	**Low**

Mitigation

- Conduct public sensitization programs on importance not interfere with the sewer pipeline and the need to seek official water connection from LIWASCO
- Constant inspection by LIWASCO officials to indentify and repair the punctures pipelines
- Prosecute persons illegally connecting to the sewer lines as provided by County Government By laws

iii. Risks of Water Pollution from overflowing and blockage of Sewers

There is a possibility of contaminating the nearby rivers from the overflowing manholes as a result of blocked sewer trunks during operation phase.

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-3
Duration of Impact	-4
Overall score	**-3**
Interpretation	**Moderate**

Mitigation measures

- Regular inspection of the system to ensure performance is maintained at high levels;
- Blockages should be detected and promptly replaced;
- Regular monitoring and sampling of the waste water at influent and effluent points as well as in the receiving water bodies;
- Communities living within the river basins where the trunk sewers will be constructed should be enlightened on dangers of using raw sewerage to irrigate farmlands.

iv. Land and Soil Contamination

Possible erosion and soil loss near burst sewer lines or manhole overflow locations running along steep slopes. The related land could be contaminated

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-3
Duration of Impact	-4
Overall score	**-3**
Interpretation	**Moderate**

Mitigation measures

- LIWASCO to attend to burst pipes promptly to prevent excessive loss of soil;
- Provide high risk areas with appropriate drainage for effective channelling of burst sewage spills;
- Encourage land owners along sewer lines to maintain vegetated belts along the pipeline to

control any overflows flows and trap soil. They should be encouraged to take responsibilities at the lowest levels in regard to protecting the sewer line;
- Mark clearly the pipeline for ease of identification and protection by the adjacent landowners

7.6.2 Negative Impacts Associated with Sewer Treatment Plant

i. Odour Menace from Wastewater Treatment Works

The process of wastewater collection, conveying or treatment has the potential to generate and release odours to the surrounding area. Most odour problems occur in the collection system, in primary treatment facilities and in solids handling facilities as well as the sludge drying beds.

The most frequently reported symptoms attributed to odours from treatment plants include headache, nausea, hoarseness, cough, nasal congestion, palpitations shortness of breath, stress, drowsiness, alterations in mood, and eye, nose, and throat irritation. Hydrogen Sulphide (H2S) is the most prevalent gas associated with domestic wastewater collection and treatment.

The conditions leading to H2S formation usually favour the production of other odorous gases such as ammonia which may have considerably higher detectable odour thresholds, and consequently H_2S may be an indicator of their presence. Exposure of receptors to levels of hydrogen sulphide above 5ppb can lead to odour nuisance.

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-3
Duration of Impact	-4
Overall score	**-3**
Interpretation	**Moderate**

Mitigation
- Ensure appropriate covering/ventilation of the pre-treatment unit;
- Ensure appropriate handling and removal of grit/grease;
- Ensure proper sizing and alignment of the lagoons;
- Ensure scum is appropriately disposed off or properly stabilized;
- Ensure that the pond series have adequate water flow and aeration to reduce the potential of odour formation;
- The perimeter of the proposed site should be vegetated with trees and plants of varying heights thereby forming windbreaker and reduce dispersion of odour;
- Repair the roofs of the sludge drying beds to ensure quick drying of sludge and appropriate disposal to reduce odour emanating from wet sludge.

ii. Inversion of Birds and Reptiles to the Waste Water Treatment Works

There is a possibility of birds attraction to the sewage treatment plants arising from proliferation of insects and aquatic flora suitable for birds food. Certain species and population of birds at Sewage treatment plant could become a safety risk to aviation sector, however no flight corridor was indentified within the vicinity. Certain animals including snakes may encroach the sewage treatment plants and other areas arising from overgrown vegetations. This will not only be a

nuisance to the plants' operations but also pose safety threats to the immediate residents and commercial premises,

The sewage discharging from the treatment plants (as well as other discharges from sources) are a determinant of the macro and micro flora and fauna in rivers Excessive nutrients will lead into increased eutrophication of the river waters while chemical and organic loading will reduce the capacity for the rivers waters to support life (low oxygen levels and toxic conditions).

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-2
Duration of Impact	-4
Overall score	**-3**
Interpretation	**Medium**

Mitigation Measures

- The sewage treatment plants should be protected from wildlife encroachments by providing secure barriers to keep off the animals from interfering with the plant operations and safety. This will also ensure safety of the residents,
- In the event of larger wildlife e.g. hippos and crocodiles, AWSB and LIWASCO will ensure appropriate consultations with the Kenya Wildlife Services (KWS) on appropriate management actions,
- The quality of the discharging sewage into the river will be an important parameter on the regional control of the river eutrophication. Continuous generation and sharing of sewage quality data on pre-scheduled monitoring programmes will be necessary

iii. Health and Hygiene Risks Associated with Sludge Management and Disposal

Sludge from the waste water treatment works is normally dried at sludge drying beds and sold off to farmers, if sludge is not appropriately handled it could pose health and hygiene risks to workers and community and also posed danger to farmers who use sludge as manure. Impact rating is presented below

Impact Scoring

Severity of Impact	-2
Spatial Scope of the Impact	-2
Duration of Impact	-4
Overall score	**-3**
Interpretation	**Medium**

Mitigation

- Provide workers with education and awareness on safe management, handling and application of the sludge cake. This will include appreciation of the materials for soil conditioning to surmount the cultural barrier,
- The quality and safety of the sludge cake should be ensured on a collaborative basis with (public health, agriculture, water and soil) before it is released to the users.
- Part of ensuring this would be ensuring efficiency of the sludge digestion and effective sludge drying,
- There should be an initiative to investigate the target areas of sludge use in respect of environmental features (water sources and soil types) as well as social interactions.

- The opinion of the large communities in the areas of sludge use should also be known.

iv. Increase in Social Vices

There if high likelihood of vandalism of the sewer equipments could occur during the operational stage if proper security measures are not put in place. This vandalism is common where manhole covers and step irons are made of iron are stolen by metal scrap dealers.

Impact Scoring

Severity of Impact	-1
Spatial Scope of the Impact	-1
Duration of Impact	-4
Overall score	**-3**
Interpretation	**Medium**

Mitigation measures

- Proper security measures should be put in place to guard the equipments 24 hours to reduce cases of vandalism.
- Design manholes and manhole step iron from material which do not have any value in the scrap metal industry.
- The design has proposed a security chain link fence including a gate and guard house be erected at sewer treatment plant to protect the site from theft and vandalism.

7.7 Positive Environmental Impacts during decommissioning phase

This section describes the anticipated positive and negative impacts during decommissioning stage. Most of the mitigation measures for these impacts are already discussed in the previous sections.

7.7.1 Positive Impacts of decommissioning

(a) Employment opportunities

This a positive impact where both skilled, semi-skilled and unskilled workers will be employed during decommissioning phase.

(b)Site Rehabilitation

Decommissioning phase will lead to rehabilitation of the site that was cleared to pave way for construction activities. This will ensure that the environment is left as natural as possible close to or better than before.

7.7.2 Negative Impacts of Decommissioning

(a) Loss of jobs and income

The people that will be employed to operate and maintain the water and sewerage Project system will lose their jobs immediately after the closure of the project. The loss of jobs will have far reaching impacts as it will lead to loss of income and social stress.

Mitigation measures include:

- Notify the employees in advance on the Project closure date and adequately compensate

them;
- Dismissal procedures to be compliant with Employment Act, 2007;
- Provide counselling & alternative skills for alternative activities;
- Employer should find alternative means of livelihood for the staff who were employed at the solar power plant.

(b) Noise Pollution

Activities likely to produce noise during decommissioning include demolition of structures and excavation of pipeline works and structures at the intake areas as well as any staff offices and quarters built on site.

Mitigation measures include:

- Schedule noisy activities during the day time period;
- Use silencers on machines where possible;
- Ensure machinery is well maintained to reduce noise emitted.

(c) Odour and Air/dust Pollution

This is expected to result from demolishing of structures and excavation of waste water pipelines. This will affect demolition staff as well as the neighbouring residents

Mitigation measures include:

- Practice dust management techniques, including watering down during drier period;
- Flush pipes and tanks of sewer appropriately before decommission;
- Set up dust barriers/ screens at strategic locations;
- Provide and enforce the appropriate use of PPE against dust.

(d) Solid Waste Material

It is expected that large amounts of solid waste material arising during decommissioning will include: glass panels, stones, pipes, wood, metal, paper, plastic, equipment, vegetation, etc. The proper disposal of these materials is critical.

Although demolition waste is generally considered as less harmful to the environment since they are composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment.

Mitigation measures include:

- Disposal of solid waste in compliance with EMCA 1999, 2006 Waste Management Regulations;
- Segregation of waste to encourage reuse and recycling;
- Ensuring that the contracted waste collector is registered with NEMA to collect and dispose wastes.

(e) Occupational health and safety

If not handled with care the demolition may lead to exposure of raw sewage to the workers and surrounding communities which poses as health risks to them.
Machinery and equipment used for the same also posses as danger to the workers if not handled well and with the correct PPE.

Mitigation measures include:

- Provide the correct PPE for the workers when conducting the demolition activities;
- Conduct training on health and safety procedures to the workers prior to commencement of demolition;
- Proper plans should be made prior to demolition so as to contain the raw sewage and other waste water that poses as health risk to human beings and the environment, to prevent the workers and surrounding communities from getting into contact with it.

(f) Noise and vibration

The demolition works will lead to significant deterioration of the acoustic environment within the Project site and the surrounding areas. This will be mitigated by the following measures:

- Ensure scheduled demolition timing is observed;
- Contractor to give timely prior information to stakeholders and neighbouring institutions

(g) Interference with private property

Project team should communicate with locals if activities will involve entering private property to avoid conflicts and destruction of property.

(h) Poor sanitation in Limuru Town

Demolition of the sewer expansion networks will result to recurrence of the current poor sanitation status in Limuru town. This will attract breakout of diseases that arise from poor sanitation. To mitigate this: the proponent through LIWASCO should ensure sensitize the public to support the Project implementation and its maintenance

CHAPTER 8: ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN (ESMMP)

8.1 Purpose and Objectives of ESMMP

The specific objectives of the ESMMP are to:

- Serve as a commitment and reference for the contractor to implement the ESMMP including conditions of approval from NEMA.
- Serve as a guiding document for the environmental and social monitoring activities for the supervising consultant, contractor and the client management including requisite progress reports.
- Provide detailed specifications for the management and mitigation of activities that have the potential to impact negatively on the environment.
- Provide instructions to relevant Project personnel regarding procedures for protecting the environment and minimizing environmental effects, thereby supporting the Project goal of minimal or zero incidents.
- Document environmental concerns and appropriate protection measures; while ensuring that corrective actions are completed in a timely manner.

8.2 Auditing of ESMMP

AWSB and the contractor shall conduct regular audits to the ESMMP to ensure that the system for implementation of the ESMMP is operating effectively. The audit shall check that a procedure is in place to ensure that:

- The ESMMP being used is the up to date version;
- Variations to the ESMMP and non-compliance and corrective action are documented;
- Appropriate environmental training of personnel is undertaken;
- Emergency procedures are in place and effectively communicated to personnel;
- A register of major incidents (spills, injuries, complaints) is in place and other documentation related to the ESMMP; and
- Ensure that appropriate corrective and preventive action is taken by the Contractor once instructions have been issued

8.3 Management Responsibility of ESMMP

In order to ensure the sound development and effective implementation of the ESMMP, it will be necessary to identify and define the responsibilities and authority of the various persons and Organizations which will be involved in the project. The following entities should be involved in the implementation of this ESMMP:

- AWSB/LIWASCO;
- NEMA;
- Contractor;
- Consultant ;

- County Government of Kiambu

8.3.1 AWSB/ LIWASCO

AWSB in conjunction with LIWASCO the project proponent, will be charged with the responsibility of ensuring that the proposed development has been put up in an environmentally sound manner. This can be achieved by inclusion of environmental specifications in the tender specifications, selection of renowned environmentally conscious contractors and supervision to ensure that the objectives of this ESMMP are met.

8.3.2 National Environment Management Authority (NEMA)

The responsibility of NEMA is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government of Kenya in the implementation of all policies relating to the environment.

8.3.3 The Contractor

The persons/firms contracted to put up the proposed water and sanitation projects plant will be required to comply with the requirements of the ESMMP within this report. To ensure strict compliance environmental specifications of this ESMMP should form part of the contract documents.

8.3.4 Consultant

The sourced consultant will have to ensure that the proposed ESMMP is up to date and is being used by the contractor. Periodic audits of the ESMMP will have to be done to ensure that its performance is as expected.

8.3.5 County Government of Kiambu

The relevant departmental officers in the above local authorities should be called upon where necessary during Project implementation to provide the necessary permits and advisory services to the Project implementers.

Tables 14, 15 and 16 present the ESMMP for the proposed water and sanitation Project during the construction, operation and decommissioning phases respectively wastes and debris holding sites will be cleared with maximum re-use of the debris either on surfacing the passageways or other grounds such as schools and church compounds.

Table 14: ***Construction Phase: Environmental and Social Management and Monitoring Plan***

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
Seeking approvals from NEMA for ESIA and Approval of plans from County and National Government	Delay in implementation of the Project due to objections and stop orders	Low	▪ The Contractor shall ensure that all pertinent permits, certificates and licences have been obtained prior to any activities commencing on site and are strictly enforced/ adhered to; ▪ The Contractor shall maintain a database of all pertinent permits and licences required for the contract as a whole and for pertinent activities for the duration of the contract	All the Project components <u>Responsibility</u> AWSB & Contractor	• Number of approvals / permits issued	~KShs.1M
construction campsites	Environmental degradation risks	Mediu m	▪ Isolate through fencing the camp sites from access by the public for their safety ▪ Preferably to be located on land already cleared land wherever possible ▪ The Contractor's Camp layout shall take into account availability of access for deliveries and services and any future works	Campsites <u>Responsibility</u> Contractor(s)	• Number of public outcry due to accidents	~KShs. 0.5M
Access to campsites and construction sites	Environmental degradation risks	Mediu m	▪ Utilize to the extent possible the existing public roads to avoid social and economic disruption ▪ Ensure road safety measures for the construction vehicles to the extent possible by observing all traffic regulations	Access Roads <u>Responsibility</u> Contractor(s)	• Cases of private land required • Accidents occurrence incidences	No direct cost associated
Environmental and Social Training and Awareness	Risks of Environmental and Social degradation risks and occupational health and safety related accidents	High	▪ The Contractor and sub-contractors shall be aware of the environmental requirements and constraints on construction activities contained in the provisions of the ESMMP ▪ The Contractor will be required to provide for the appropriate Environmental Training and	All Workers <u>Responsibility</u> Contractor(s)	• Number of Trainings Held • Availability of Training reports • Attendance list of	KShs. 0.5M

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
			Awareness as described in this ESMMP in his costs and programming ▪ An initial environmental awareness training session shall be held prior to any work commencing on site, with the target audience being all project		participants during the trainings sessions	
HIV/AIDS awareness and prevention campaign	Risks of Increased HIV and Aids transmission in the area	Medium	▪ The Contractor shall institute HIV/AIDS awareness and prevention campaign amongst his workers for the duration of the contract, contracting an implementing organisation, with preference for an organisation already working on this issue in the Project area; ▪ The campaign shall include the training of facilitators within the workers, information posters in more frequented areas in the campsite and public areas, availability of promotional material (T-shirts and caps), availability of condoms (free), and theatre groups	All Workers <u>Responsibility</u> Contractor(s)	• Number of Trainings Held • Availability of Training reports • Attendance list of participants during the training sessions	KShs. 0.5M
Setting out and clearance of Project routes and site	Delay in Project implementation due to opposition from PAPs	Medium	▪ Ensure that land acquisition is done within the provision of Land Act 2012 ▪ Prepare and Implement RAP recommendations before commencement of civil works	All the Project Lots <u>Responsibility</u> Contractor & AWSB	• Numbers of satisfied PAPS • Extend of route opened to the contractor	~KShs. 1M
Local Labour / Employment	Delay in Project implementation due to opposition from aggrieved community members	Medium	▪ Wherever possible, the Contractor shall use local labour, and women must be encouraged to be involved in construction work ▪ The contractor shall ensure compliance to the gender balance as required by the 2/3 gender rule	All the Project Lots <u>Responsibility</u> Contractor	• Number of workforce employed from the local community • Number of	No direct costs associated

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
					female employed	
EMP management records	Risks of non conforming to ISO 9001 on QMS and ISO 14001 on EMS	Medium	▪ The updated version of the EMP should be kept on site ▪ Copies of all necessary permits and licences should be kept on site ▪ All site specific plans prepared as part of the updated ESMMP ▪ All related environmental, social, health and safety management registers and correspondence, including any complaints ▪ A register of audit non-conformance reports and corrective actions	All the Project Components <u>Responsibility</u> Contractor	• Number of available permits on site • ISO audit report on non conformities • Number of corrective measure adopted	No direct associated costs
Earth moving and excavations (Vegetation clearance, channeling and site preparations)	▪ Safety risks ▪ Air pollution ▪ Social nuisance	Medium	▪ Provide notices, signage and information to the public for their safety at all locations ▪ Install barriers along walkways, crossings and public places affected by the works for public safety ▪ Where there are potential for nuisance from dust generation, ensure earth moving is under dump conditions (consider watering where necessary) ▪ Inform immediate communities or stakeholders of the activities.	All work areas <u>Responsibility</u> Contractor(s)	• Accidents occurrence incidences • Cases of respiratory complication at nearby health centre	~KShs. 1M
	▪ Vegetation Cover destruction ▪ Loss of biodiversity	Low	▪ Construction activities will be limited to Project sites / routes which already exist therefore limited destruction to vegetation cover	All work areas <u>Responsibility</u> Contractor(s)	• Soil erosion extend and intensity on site	
	▪ loss of top soil	Low	▪ Stock piling of top soil, construction material and wastes should be done only	All work areas	• Soil erosion extend and	

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
			at designated sites approved by the supervising engineer, erosion prevention through berming of loose soil sites should be done in all areas susceptible to agents of erosion	Responsibility Contractor(s)	intensity on site	
	▪ Public Health ▪ Worker Occupational safety risks	Mediu m	▪ Notify public the intent to cut sections of the road for safety precautions ▪ Provide signage and safety information in all work areas ▪ Ensure compliance by workers with safety safeguards including the OHS, provision of safety gear and enforcement of application	civil works areas Responsibility Contractor(s) Supervision	• Accidents occurrence incidences	KShs. 1.0M
	Disruption of amenities (access roads, services lines and driveways) causing inconveniences to the community	Mediu m	▪ Notify other services providers and ▪ Open small sections that can be reinstated within the shortest period to avoid public disruption ▪ Mark the lines to avoid conflicts with other activities	civil works areas Responsibility Contractor(s) Supervision	• Number of complaints from community due to lack of certain services	
Materials sourcing, from burrow pits and quarries delivery and storage	Environmental and Safety risks associated with burrowing and opening up of new quarry sites	High	▪ The Contractor will be responsible for ensuring that appropriate authorisation to use the proposed borrows pits and quarries have been obtained before commencing activities ▪ Topsoil shall be stripped prior to removal of borrow and stockpiled onsite. This soil shall be replaced on the disturbed once the operation of the borrow site or quarry is complete ▪ Construction material sources should be environmentally sustainable (approved accordingly) ▪ Delivery routes and modes of transport	Burrow Pits and Quarry Site Responsibility Contractor(s) Supervision	• Environmen tal Status of reinstated burrow pits • Complains from the community on burrow pits and material transportati on	KShs. 1.0M

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
			should be approved ▪ Material storage on site not to be internal or external nuisance			
Concrete / cement batching plant	Risks associated with water resource pollution, noise and vibration and air pollution from dust this could lead to respiratory problems	High	▪ Where required, a Concrete batching plant shall be located more than 20m from the nearest stream/river channel; ▪ Top soil removed from the batching plant site and stockpiled ▪ Contaminatedstorm-waterandwastewaterrunofffromthebatchingareaandaggregate stock piles shall not be permitted to enter streams but shall directed to a pit where the water can soak away ▪ Suitable screening and containment shall be in place to prevent windblown contamination associated with any bulk cement silos, loading and batching ▪ Cleaning of equipment and flushing of mixers shall not resulting pollution of the surroundingenvironment	Concrete / cement batching plant <u>Responsibility</u> Contractor(s) Supervision	• Number of incidence of Environment pollution around the plant	KShs. 1.0M
Wastes generation and disposal	Risks of contaminating surface and underground water resources	High	▪ Construction wastes (residual earth, debris and scrap materials) to be removed for safe disposal ▪ Encourage recycling where possible (concrete debris for access road surfacing), ▪ Contaminated organic matter in the work areas to be isolated for safe disposal ▪ Material residuals to be disposed off in accordance with established regulations	Construction areas <u>Responsibility</u> Contractor(s) Supervision	• Number of complaints from community not happy with waste management of the contractor	KShs. 0.5M
Spoil Storage site	Risks of solid waste mismanagement	Medium	▪ Preferably to be located on land already cleared wherever possible. Communities	Construction areas	• Number of complaint	Contractor best management

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
	leading to pollution		shall be involved in the site location to avoid conflict ▪ The need to be more than 20meters from water courses and in a position that will facilitate the prevention of storm-water runoff from the site from entering the watercourse ▪ Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site ▪ The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials' creep' into' no-go 'areas	<u>Responsibility</u> Contractor(s) Supervision	s from communit y not happy with waste managem ent of spoil material	practice
Occupational Health and Safety	Risks of Accidents, Injuries or death of workers or community member	High	▪ Provide construction workers with personal protective gear (gloves, gum boots, overalls and helmets), ▪ Provide temporary toilets and bathrooms for the construction workers at the work sites ▪ Provide onsite first aid kit accessible by the workers on need, ▪ Isolate the site for access by the local communities during the construction for their safety and health ▪ Contractor to provide a Healthy and Safety Plan prior to the commencement of works to be approved by the resident engineer.	All work areas <u>Responsibility</u> Contractor(s) Supervision	Accidents occurrence incidences	KShs. 1.0M
Storage of fuel oils, lubricants, chemicals and flammable materials	Hazards of fire outbreak, oil and chemical spills.	High	▪ Follow specifications of the Occupational Health and Safety Act, EMCA1999 and others in the development and operation of stores.	All work areas <u>Responsibility</u> Contractor(s) Supervision	Incidence of reported cases of fuel leaks and fire incidences	No direct cost associated

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
Sanitation issues resulting from both solid and liquid wastes on site.	Risks associated with water born diseases exposed to community and workforce	Medium	▪ The Contractor shall -laws relating to public health and sanitation ▪ All temporary/ portable toilets or pit latrines shall be secured to the ground to the satisfaction of the RE to prevent them from toppling over ▪ A wash basin with adequate clean water and soap shall be provided alongside each toilet .Staff shall be encouraged to wash their hands after use of the toilet, in order to minimise the spread of possible disease	All work areas Responsibility Contractor(s) Supervision	Incidence of reported cases of water related diseases among the workforce and neighbor community	No direct cost associated
Noise and Vibration control from plant and equipment	Risk to health and safety of community and workers	Medium	▪ The Contractor shall keep noise level within acceptable limits and construction activities shall, where possible, be confined to normal working hours in the residential areas ▪ hospitals and other noise sensitive areas shall be notified by the Contractor at least 5 days before construction is due to commence in their vicinity ▪ Any complaints received by the Contractor regarding noise will be recorded and communicated to the RE ▪ The Contractor must adhere to Noise Prevention and Control Rules of April 2005	civil works areas and access roads Responsibility Contractor(s) Supervision engineer	Reported complaints from neighbor community and institutions	No direct cost associated
Traffic management on site	Risks of Accidents, Injuries or death of workers or community member	high	▪ Strict use of warning signage and tapes where the trenches are open and active sites ▪ Employ and train road safety Marshalls who will be responsible for management of traffic on site ▪ Contractor to provide a traffic management plan during construction to be approved by the resident engineer	.civil works areas and access roads Responsibility Contractor(s) Supervision engineer	Accidents occurrence incidences	KShs. 0.5M

Activity	Associated Impacts	Impact Levels	Management Actions	Target Areas& Responsibilities	Monitoring Indicator	Budget
Air Quality Control	Air pollution causing respiratory disorders to human	High	▪ Workers shall be trained on management of air pollution from vehicles and machinery. All construction machinery shall be maintained and serviced in accordance with the contractor's specifications ▪ The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilised as soon as practically possible ▪ The contractor shall not carry out dust generating activities (excavation, handling and transport of soils) during times of strong winds ▪ Vehicles delivering soil materials shall be covered to reduce spills and windblown dust ▪ Water sprays shall be used on all earthworks areas within 200metres of human settlement.	All work areas <u>Responsibility</u> Contractor(s) Supervision	Cases of respiratory complication at nearby health centre	No direct costs (integrated in the works costs)
Contractor de-mobilization and site reinstatement	Associated risks of environmental degradation	High	▪ The site is to be cleared of all construction materials, including litter prior to hand over ▪ Fences, barriers and demarcations associated with the construction phase must be removed from the site ▪ Fences, barriers and demarcations associated with the construction phase must be removed from the site ▪ Rehabilitation Activities of Environmental Cases identified must continue throughout the defect liability period	All work areas <u>Responsibility</u> Contractor(s) Supervision	Closeout audit report findings	No direct anticipated
Total Estimated Cost for EMP and RAP implementation ***Include Chance Find Procedures BP OP 4.11in all contracts ***					**EMP**	**KES 9.5M**

Table 15: Operational Phase: Environmental and Social Management and Monitoring Plan

No.	Issue	Action required	Responsibility	Monitoring Indicator	Provisional Budget
1	Risk of encroachment and construction of structures on the sewer wayleaves	• Mapping and installation of beacons to which illustrate the width of the pipeline reserve • Regular inspection of the pipeline corridor for encroachment. • Prosecution of encroachers as required by City County By laws on way leaves and road reserves maintenance. • Conduct public sensitization programs on importance not interfering with way leaves and public reserve land	LIWASCO Kiambu County Government	Number of encroachment cases reported	To be established at operation phase and included in the operation of the projects
2	Risk of illegal connection to the Sewer pipeline	• This will require constant inspection by LIWASCO officials to indentify and repair leakages • Conduct public sensitization programs on importance not interfering with the water pipeline and the need to seek official water connection from LIWASCO	LIWASCO	Number of illegal connection cases reported	To be established at operation phase and included in the operation of the projects
3	Risk of inversion of birds, rodents, mammals and associated reptiles	• Keep the sewer treatment plant clean to limit the attraction of birds which scavenge for insects and maggots from the ponds and sludge beds • The sewage treatment plants should be protected from wildlife encroachments by providing secure barriers to keep off the animals from interfering with the plant operations and safety. This will also ensure safety of the residents, • In the event of larger wildlife e.g. hippos and crocodiles, AWSB and LIWASCO will ensure appropriate consultations with the Kenya Wildlife Services (KWS) on appropriate management actions, • The quality of the discharging sewage into the river will be an important parameter on the regional control of the river eutrophication. Continuous generation and sharing of sewage quality data on	LIWASCO	Type of and average numbers of birds, mammals and reptiles reported	To be established at operation phase and included in the operation of the projects

No.	Issue	Action required	Responsibility	Monitoring Indicator	Provisional Budget
		pre-scheduled monitoring programmes will be necessary			
4	Risk of Sewer blockage and overflows to the environment	• Awareness rising among community members not to dump solids in manholes. • Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups • Development of an inventory of system components, with information including age, construction materials, and drainage areas served elevations. • Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize entry of garbage and silt into the system • Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulphide generation	LIWASCO	Number of cases of sewer overflow indentified and repaired	To be established at operation phase and included in the operation of the projects
5	Risk of Vandalism of the infrastructure (Manhole covers and man hole step irons)	• This is common when the manhole covers are made using steel and concrete, also step iron bars in the manholes, the steel is usually stolen by steel scavengers	LIWASCO	Number of manholes vandalized	To be established at operation phase and included in the operation of the projects
6	Sludge handling and disposal	• Repair the roofs of the sludge drying beds to ensure quick drying of sludge and appropriate disposal to reduce odour emanating from wet sludge. • Provide workers with education and awareness on safe management, handling and application of the sludge cake. This will include appreciation of the materials for soil conditioning to surmount the cultural barrier, • The quality and safety of the sludge cake should be ensured on a collaborative basis with (public health, agriculture, water and soil) before it is released to the users.	LIWASCO	Status of sludge at the WWTW	To be established at operation phase and included in the operation of the projects

No.	Issue	Action required	Responsibility	Monitoring Indicator	Provisional Budget
		• Part of ensuring this would be ensuring efficiency of the sludge digestion and effective sludge drying,			
7	Air pollution from odour emanating from wastewater treatment works	• Plant trees especially bamboos and eco friendly indigenous trees around the waste water treatment plant to limit exposure of neighbourhood to adour menace. • Ensure appropriate covering/ventilation of the pre-treatment unit; • Ensure appropriate handling and removal of grit/grease; • Ensure scum is appropriately disposed off or properly stabilized; • Ensure that the ditches have adequate water flow and aeration to reduce the potential of odour formation; • The perimeter of the proposed site should be vegetated with trees and plants of varying heights thereby forming windbreaker and reduce dispersion of odour; • •Repair the roofs of the sludge drying beds to ensure quick drying of sludge and appropriate disposal to reduce odour emanating from wet sludge	LIWASCO	Number of Complains recorded in the log book concerning odour	To be established at operation phase and included in the operation of the projects
8	Land and Soil Contamination	• The LIWASCO to attend to burst pipes promptly to prevent excessive loss of soil; • •Provide high risk areas with appropriate drainage for effective channelling of burst sewage spills; • •Encourage land owners along sewer lines to maintain vegetated belts along the pipeline to control any overflows flows and trap soil. They should be encouraged to take responsibilities at the lowest levels in regard to protecting the sewer line; • •Mark clearly the pipeline for ease of identification and protection by the adjacent landowners	LIWASCO	Soil analysis report within sampling areas around the WWTW	To be established at operation phase and included in the operation of the projects

No.	Issue	Action required	Responsibility	Monitoring Indicator	Provisional Budget
9	Increase in social vices	• Proper security measures should be put in place to guard the equipments 24 hours to reduce cases of vandalism; • The design has proposed a security chain link fence including a gate and guard house be erected at WWTW to protect the site from theft and vandalism	LIWASCO	Number of security incidences recorded at the guards office.	To be established at operation phase and included in the operation of the projects

8.4 Decommissioning Flow Chart

The Project has been designed to operate effectively for over 20years. In the event that the infrastructure will be required to be overhauled, then the following steps should be considered in order to undertake the procedure in a structured manner with minimum impact to both human and natural environment as illustrated in **table 16** below

Table 16: Decommissioning Flow Chart

Stage	Action	Actor
Step 1	**Initiation** Development of an Objective Worksheet and checklist incorporating references, legal and policies Undertake decommissioning audit	**Proponent then**
Step 2	**Prepare Road Map for Decommissioning Design** Conduct design review to validate elements of the design and ensure design features are incorporated in the decommissioning design. Public consultations	**Proponent then**
Step 3	**Prepare and Award Contract** Prepare a contract that incorporates validated Project information and award to a contractor as per the Procurement rules.	**Proponent then**
Step 4	**Execute Decommission Works** Implement design elements and criteria on the Project in accordance with specifications and drawings. Inspect during decommissioning and at Project completion to ensure that all design elements are implemented according to design specifications.	**Contractor**
Step 5	**Commissioning Environmental Management Plan**	**Contractor**
Step 6	**Non-Conformance, Corrective/Preventive Action** Determine root cause Propose corrective measures Propose future preventive measures.	**Contractor**

CHAPTER 9: CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion and Recommendations

Through the assessment and evaluation of all environmental concerns of the proposed Limuru Sewerage Project, it can be concluded that the establishment will bring a net ecological, economic, social and health benefits to all living within the county. On the other hand, some of the Project components are envisaged to have negative impacts depending on the different phases and components of the project. These impacts have been discussed in great details in this report and mitigation measures proposed.

In order to alleviate the expected negative impacts and to make the Project environmentally sounder, an ESMMP has been prepared, and it includes: the mitigation plan; the monitoring and enforcement requirements; and the responsible persons/organizations. All the recommendations/ mitigations mentioned in the assessment should be financed, and incorporated in the construction and supervision contracts. These include:

- Capacity building for Project component management;
- Preparation and Implementation of Resettlement Action Plans (RAP) for Project components interfering with private assets and sources of livelihood.
- Occupational, Health and Safety gadgets such as fire fighting equipments, PPE, disaster management training, first aid training among others;
- Water quality monitoring and effluent quality monitoring;
- Ambient air emission monitoring;
- Solid and hazardous waste monitoring;
- Noise level monitoring;
- HIV/AIDS awareness programmes.

With implementation of the above, the Project will be economically, socially and ecologically viable throughout its lifespan

ANNEXES

Annex 1 Public Participation Minutes and List of Participants

Annex 2 Project layout Plans