Environmental and Social Impact Assessment Study Report – KIMILILI TOWN

Feasibility Study, Detailed Design and Preparation of Tender Documents for Mumias - Kimilili Sewerage Project

Contract No.: RVWSB/LVN/KTSWSSP/C/MUMIAS – KIMILILI/2018 - 2019

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SMEC Company Details

Approved by:	CHIKE UCHENDU		
Address:	General Mathenge Gardens 240, off Lower Kabete Road (Westlands), P.O. Box 14094 – 00800, NAIROBI, Kenya.		
Signature:	[Insert signature of approving manager]		
Tel:	+254 20 4441541/2	Fax:	+254 20 4441543
Email:	Chike.Uchendu@smec.com	Website:	www.smec.com

DECLARATION

I, **Charles Lwanga Muyembe** on behalf of SMEC, submit this **Environmental and Social Impact Assessment (ESIA) Study of the Feasibility Study, Detailed Design and Preparation of Tender Documents for Kimilili Sewerage Project** The ESIA report has been prepared in accordance with the Client Guidelines, Environmental Management and Coordination Act, Cap 387, and the Environmental (Impact Assessment and Audit) Regulations, 2003 (and the amendment Regulations of 2016).

Signed at NAIROBI on this ……day of……2021

Signature: ……

Designation: ESIA/AUDIT LEAD EXPERT REG. NO.1283

I, …….. on behalf of Central Rift Valley Water Works Development Agency, submit this **Environmental and Social Impact Assessment (ESIA) Study of the Feasibility Study, Detailed Design, and Preparation of Tender Documents for Kimilili Sewerage Project**. The ESIA has been prepared in accordance with the Client Guidelines, Environmental Management and Coordination Act, Cap 387, and the Environmental (Impact Assessment and Audit) Regulations, 2003 (and the amendment Regulations of 2016).

Signed at …….. on this …… Day of …….. 2021

Signature…….

Designation: ……

CONTACT DETAILS: ……

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A. EXECUTIVE SUMMARY

1. Project Background

The Government of Kenya has received financing from the Africa Development Fund (AfDF or "or Fund") to support the Kenya Sustainable Towns Water Supply and Sanitation Programme. The programme aims at contributing to the quality health of life and reducing poverty levels of the population of Kenya through provision of water and sanitation services on a suitable basis.

The main objective of the program is to improve the access, availability and sustainability of water supply and wastewater management services in multiple towns with a view to catalysing commercial activities, driving economic growth, improving quality of life of people and building resilience against climate variability and change.

To achieve this objective, the Rift Valley WWDA has on behalf of Lake Victoria North WWDA, has prioritized the design of the Mumias - Kimilili Sewerage Project.

2. Purpose of the ESIA

Environmental and Social Impact Assessment (ESIA) is designed to establish a triangular relationship between the proposed Project, natural ecosystems, social setting and co-existence. The study, therefore, will relate the project and key environmental, social and economic areas and related linkages for ease of integration in the implementation of the project right from the planning stage through construction, commissioning and eventually long term use.

The overall study objective of the assignment is to develop the most cost-effective system to address collection, treatment and disposal with design output that is focused on the following:

- Capable of performing the intended functions throughout the design life;
- Environmentally acceptable, both during construction and in the long term;
- Economical in terms of both capital and recurrent costs.

The Central Rift Valley Water Works Development Agency (hereafter referred to as the Client) has engaged SMEC Kenya in association with SMEC International (hereafter referred to as the Consultant) to conduct the Consultancy Services for the Feasibility Study, Detailed Design, and Preparation of Tender Documents for Mumias-Kimilili Sewerage Project (hereafter referred to as the Project).

3. Study Methodology

The Environmental and Social Impact Assessment followed the following procedure; screening, scoping, site assessment, baseline studies, impact analysis and provision of mitigation measures, project alternatives, Environmental and Social Management Plan and the Environmental Monitoring Plan.

4. Baseline

The proposed project location is within Kimilili town and its environs, Bungoma County. The specific project areas include:

- Town Centre/Kimilili CBD;
- Kamusinga area;
- Khamulati area;
- Kimilili – Kamukuywa Rd. area;
- Jonaf Farm area;
- Kimilili Old Market and environs;
- Kimilili Bus Park;
- Kamtiong Market and environs;
- Areas along River Kibisi;
- Matili Technical Training Institute and environs;
- Maeni.

5. Project Description

The proposed Kimilili Sewerage System project scope as outlined in SMECs' Detailed Engineering design is as shown in the table below:

Table A-1: Proposed Kimilili Sewerage Project Scope

Phase 1	Phase 2
• Kimilili WWTP – Capacity **3,600m^3/day**, comprising anaerobic ponds, facultative ponds, maturation ponds and sludge drying beds; site entrance gate, security fencing, inlet Works, office building, staff houses and laboratory; • Sewers length - **44,458 m**; • Supply of sanitation equipment including Suction truck 10m^3 and Truck (7.5 tonne) with hydraulic host; • 500 Nr. Consumer connections.	• Expansion of the Kimilili WWTP capacity to **5,000m^3/day**, by addition of **2Nr. Trickling Filters**.

6. Policy, Legal and Regulatory Framework

Some the Policies reviewed include the Kenya Vision 2030, Sessional Paper No. 10 of 2014 on the National Environment Policy, National Water Policy, 2012, the public health policy of 2014, Kenya National Policy on Gender and Development, 2000 and the draft National Land Use Policy, 2016.

Institutional framework reviewed includes; Ministry of Water and Irrigation, Ministry of Environment and Forestry, EMCA, CAP 387 Administrative Framework, National Environment Action Plan Committee, County Environment Committees and the National Environment Restoration Fund.

Legal framework reviewed include; Environmental Management and Coordination Act CAP 397, the Environment and Land Court Act, 2011, the Water Act, 2016, The land Act, 2012, The Agriculture, Fisheries and Food Authority Act, 2013, the Energy Act 2006, Penal Code Act CAP 63, County Government Act 2012, Occupational Health and Safety Act 2007, Public Health Act CAP 242, and the Physical Planning Act 1996.

AfDB safeguards triggered by the project include: Environmental Assessment OP 4.01, and Involuntary Resettlement (OP 4.12).

International conventions and treaties were also reviewed.

7. Potential Impacts and Mitigation Measures

The main objective of this assessment was to identify significant potential impacts anticipated from the proposed development of Kimilili Town Sewerage System to the environment and social aspects with a view to establishing appropriate recommendations on ensuring that the proposed project takes into consideration appropriate measures to mitigate any adverse effects to the environment.

The following is summary of the anticipated environmental impacts.

Some of the positive impacts identified are as the summary below, they are discussed broadly in Chapter 7 of this report:

- Employment opportunities;
- Stimulation of local economy;
- Improved sanitation;
- Improved living standards of Kimilili residents;
- Reduced exposure to health risks;
- Improved food security and nutrition;
- Sustainability of Nzoia Water Services Company Limited.

Some of the negative impacts identified are below, mitigation measures for the same are outlined in Chapter Seven:

- Land take;
- Accidental sewer bursts;
- Risk of contamination;
- Risk of illegal connections;
- Loss of structures/vegetation;
- Occupational Health and Safety Risks.

8. Environmental and Social Management Plan

Environmental and Social Management Plan (ESMP) for developing projects is given to provide a logical framework within which identified negative environmental impacts can be mitigated and monitored. In addition, the ESMP assigns responsibilities of actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done and their budgetary element.

9. Conclusions and Recommendations

The ESIA study has established that the proposed Sewer system in Kimilili town by Central Rift Valley Water Works Development Agency is a worthy investment by the proponent and without a doubt will contribute significantly to the economic development of the country.

However, the ESIA study has established that the proposed project will also have some negative impacts. The proponent shall be committed to putting in place several measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project. It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the Environmental Management Plan as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects in Kenya. It is expected that the positive impacts that emanate from such project shall be maximized as much as possible as exhaustively outlined within the report.

Considering the positive socio-economic and environmental benefits which will accrue because of the proposed development and the ESIA project having found no major impacts to arise from the development, it is our recommendation that the project be allowed to proceed on the understanding that the proponent will adhere to the mitigation measures recommended herein and will further still implement the proposed Environmental Management Plan to the latter. Kimilili town has an insignificant sewerage system, therefore, the proposed expansion of the Kimilili sewer system will go a long way in solving part of the existing challenges experienced by the water and sanitation sector and sector and the residents.

B. ABBREVIATIONS AND ACRONYMS

Table B-1: Abbreviations and Acronyms

ABBREVIATION/ ACRONYM	DESCRIPTION
AfDB	African Development Bank
amsl	Above Mean Sea Level
BOD	Biochemical Oxygen Demand
BS	British Standards
BS EN	British adoption of a European (EN) standard
CBOs	Community Based Organizations
CEC	County Executive Committee Member
COD	Chemical Oxygen Demand
CRVWWDA	Central Rift Valley Water Works Development Agency
CSR	Corporate Social Responsibility
DWC	Double Wall Corrugated
EHS	Environmental Health and Safety
EMCA	Environmental Management and Co-ordination Act
EMP	Environmental Management/Monitoring Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
FGDs	Focused Group Discussions
GHGs	Greenhouse Gases
GoK	Government of Kenya
HC	House Connections
KTSWSSP	Kenya Towns Sustainable Water Supply and Sanitation Programme
LVNWWDA	Lake Victoria North Water Works Development Agency
MWIPMSS	Ministry of Water and Irrigation Practice Manual for Water Supply Services in Kenya
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NHC	National Housing Corporation
NRW	Non-Revenue Water
NZOWASCO	Nzoia Water Services Company Limited
OSHA	Occupational Safety and Health Act
PAP	Project Affected Person
PPE	Personal Protective Equipment
RAP	Resettlement Action Plan
SMEC	Snowy Mountains Engineering Corporation
SWM	Solid Waste Management
TDS	Total Dissolved Solids
ToR	Terms of Reference
TSS	Total Suspended Solids

ABBREVIATION/ ACRONYM	DESCRIPTION
UfW	Unaccounted for Water
UNCHS	(UN-Habitat) The United Nations Human Settlements Programme
uPVC	Un-Plasticised Polyvinyl Chloride
WASREB	Water Services Regulatory Board
WHO	World Health Organisation
WIBA	Work Injury Benefit Act
WRA	Water Resources Authority
WSP	Water Service Provider
WSS	Water Supply and Sanitation
WWTP/W	Wastewater Treatment Plant/Works

1 INTRODUCTION

1.1 Project Background

The Government of Kenya has received financing from the Africa Development Fund to support the Kenya Sustainable Towns Water Supply and Sanitation Programme. The programme aims at contributing to the quality health of life and reducing poverty levels of the population of Kenya through provision of water and sanitation services on a sustainable basis.

The main objective of the program is to improve the access, availability and sustainability of water supply and wastewater management services in multiple towns with a view to catalysing commercial activities, driving economic growth, improving quality of life of people and building resilience against climate variability and change.

To achieve this objective, the Lake Victoria North Water Works Development Agency (LVNWWDA), through the Central Rift Valley Water Works Development Agency (CRVWWDA) has prioritized the design of the Mumias - Kimilili Sewerage Project.

The Central Rift Valley Water Works Development Agency (hereafter referred to as the Client) has engaged SMEC Kenya in association with SMEC International (hereafter referred to as the Consultant) to conduct the Consultancy Services for the Feasibility Study, Detailed Design, and Preparation of Tender Documents for Mumias-Kimilili Sewerage Project (hereafter referred to as the Project)

This ESIA project report covers the studies of the project areas for sewer expansion in Kimilili Town. The report is prepared following the Client guidelines, the applicable Kenyan regulations as well as the AfDB policy guidelines on Environment.

1.2 Objectives of Environmental Impact Assessment

The objective of the ESIA study is to predict, assess, and analyse the possible positive and negative environmental and social impacts that are anticipated during the construction, operation and decommissioning phases of the project. This will be done with the aim of proposing the possible mitigation measures for the negative impacts. This is in line with ensuring that the development does not impact negatively on the environment within which it is implemented.

1.3 Legal and Regulatory Framework in Kenya

The ESIA Report preparation was guided by relevant policies, legislation and institutional frameworks that are available Nationally and reference made to acceptable International guidelines. 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 2016, Environmental Management and Coordination Act, Cap 387;
- The Environmental (Impact Assessment and Audit) Regulations, 2003 (and the amendment Regulations of 2016);
- 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).

1.4 Justification of the Project

The project aims at contributing to the quality health of life and reducing poverty levels of the population of Kenya through provision of water and sanitation services on a suitable basis.

The main objective of the program is to improve the access, availability and sustainability of water supply and wastewater management services in Kimilili Town with a view to catalysing commercial activities, driving economic growth, improving quality of life of people and building resilience against climate variability and change.

The specific areas for Sewer connection in Kimilili town are:

- Town Centre/Kimilili CBD;
- Kamusinga area;
- Khamulati area;

- Kimilili – Kamukuywa Rd. area;
- Jonaf Farm area;
- Kimilili Old Market and environs;
- Kimilili Bus Park;
- Kamtiong Market and environs;
- Areas along River Kibisi;
- Matili Technical Training Institute and environs;
- Maeni.

1.5 Scope of Works

The proposed Kimilili Sewer system as outlined in SMECs' Detailed Engineering Design Report has one main trunk sewer namely K_1.

Table 1-1: Proposed Sewers

Sewer	Description
K_1 Trunk Sewer	The proposed K1 trunk main sewer originates from Kamusinga area, north of Kimilili Town Centre. It traverses the banks of River Kibisi, with two major paved road crossings on Kimilili – Kapsokwony Rd and Kimilili – Kamukuywa Rd. It then discharges wastewater effluent to the proposed Kimilili Wastewater Treatment Plant located to the south east of Kimilili Municipality, near the A1 Kakamega – Kitale Road. The sewer will serve the areas of Kamusinga, Kimilili town centre, Kimilili market, Jonaf Farm, Khamulati, Kimilili – Kamukuywa Rd., Kimilili – Kapsokwony Rd, areas along the banks of River Kimilili/Kibisi, Matili TTI and Maeni areas. The specific drainage areas to be served within this catchment include Moi Girls Kamusinga, Friends School Kamusinga, CBSM Kimilili School, Kory Family Hospital Kimilili, Kimilili Bus Stop, Banks, Shops, Offices and institutions within the CBD, Western Province Police Training College, Kimilili Sub County Hospital, Matili Technical Training Institute, Kimilili Market, Kamtiong Market and Maeni area. The trunk will therefore serve a huge proportion of the town. The K1 trunk sewer will receive wastewater flows from secondary sewers K1.1, K1.2, K1.3, K1.4, K1.5, K1.6, K1.7, K1.8, K1.9, K1.10, K1.11 and K1.12. Secondary sewer K1.1 has three lateral sewers discharging into it, namely K1.1.1, K1.1.1.1 and K1.1.2; K1.2 has one lateral sewer K1.2.1 discharging into it; K1.4 has lateral sewers K1.4.1, K1.4.2, K1.4.3, K1.4.3.1 and K1.4.4; and K1.10 has one lateral sewer K1.10.1.

The proposed wastewater treatment plant, located at Sango area in Kimilili, comprises a hybrid system of wastewater stabilization ponds and trickling filters.

1.6 Justification of the ESIA

The implementation of the proposed project will have both socio-economic and environmental impacts on the project area. In order to alleviate any detrimental effects of the project, there is need to assess possible impacts of the development on the environment and the socio-economic attributes of the project area. At first, the proposed project will be evaluated against the framework provided by the Kimilili Physical Development plan to ensure proper alignment. Then an Environmental Impact Assessment is conducted in accordance with the Client Guidelines, Environmental Management and Co-ordination Act (EMCA), Act, Cap 387, and the Environmental (Impact Assessment and Audit) Regulations, 2003 (and the amendment Regulations of 2016).

Due to the likely socio-economic impacts of the project, our Environmental Specialist and Socio-Economic Specialist have also collected socio-economic data to support the Environmental Impact Assessment and also to be used for Economic Evaluation of the Project. They were assisted by Field Assistants and a group of Enumerators especially in the process of acquiring the primary data in the field.

The execution of the assignment was carried out during the preliminary design of the Project to ensure that the designs produced comply with environmental requirements and take into account socio-economic status in the areas. The outcome of the Environmental Impact Assessment will be used to moderate the Engineers' Designs to ensure that they are in harmony with the environmental and socio-economic attributes of the project area. This approach will enhance the protection of the environment and the local community from negative effects of development.

1.7 Methodology

This section outlines the Methodology of Environmental and Social Impact Assessment in line with the Environmental Management and Coordination Act CAP 387 of 1999 and (Amendment 2015). Various stages were undertaken to realize this report. The stages are as detailed below:

1.7.1 Environmental Screening and Scoping

Owing to the nature of the project and the provisions of EMCA CAP 387, Second Schedule, Part 3 (a), this project is required to undergo an ESIA study to ascertain the impacts of the Project in the area.

At the screening stage, we determined the potential magnitude of impacts and hence the depth of study required. This is the first stage in incorporating environmental considerations into a Water Supply and Sanitation project. Scoping is a process used for defining what can and what cannot be accomplished during a particular environmental study. This process included the following:

- Defining the geographic boundary of the study in relation to possible impacts;
- Identifying the time constraints and time horizons of the study (i.e. project time limits and how far into the future one should predict project effects); and,
- Identifying the skills and human resources needed to undertake the project.
- Identify, materialize harmony with the affected / interested stakeholders and inform them of the Project and the ESIA process;
- Provide stakeholders with the opportunity to identify any issues and concerns associated with the Project;
- Identify areas of likely impact and environmental issues that may require further investigation in an ESIA; and
- Determine the need for specialist baseline and impact assessment studies in response to initial stakeholder input.

1.7.2 Desktop Study

A desktop study was conducted in order to review available published (like policies and legislations) and unpublished reports, County Integrated Development Plans and maps and information gathered from reconnaissance in order to compile relevant baseline biophysical and socio-economic information about the study area.

The biophysical information was also compiled on environmental aspects such as flora, fauna, conservation, topography, drainage, soils, geology, hydrogeology, climate and vegetation, while the socio-economic environment study compiled information on aspects such as population, land use and land tenure. This is outlined under the Baseline Information Chapter.

1.7.3 Site Assessment

Site assessment (physical inspection) was carried out between 17 -30 July 2019.The assessment entailed observation on biophysical and socio-economic environment. From this, details of the positive and negative effects of the development of the project on the environment were identified and appropriate recommendations outlined to minimize any undesirable effects resulting from proposed project.

1.7.4 Public Participation

Public participation was done by conducting interviews, discussions and public meetings with key stakeholders including members of the community in the project area to obtain their views on the impacts of the project and possible mitigation measures. This is as per the Kenyan Constitution and EMCA Cap 387. The public consultation and participation was conducted through:

- Household socio-economic survey;
- Key stakeholder interviews;
- Key stakeholder Meeting (NZOWASCO Kimilili Office);
- Public Meetings held at Kimilili Town, Khamulati and Sindani.

1.7.5 Key Stakeholder Meeting

Key Stakeholder meeting was conducted on 11th June 2019 during the reconnaissance site visit at NZOWASCO offices in Webuye Town, Bungoma County. Courtesy calls were also made to the County Commissioners' office in Bungoma town to follow protocol on publicizing the public barazas via Deputy County Commissioners, foster better mutual understanding of public concerns as well as incorporate key stakeholders' opinions regarding the proposed project.

1.7.6 Public Meetings

Three (3) public consultative meetings were conducted at the proposed sites and a total of 193 people participated in the meetings. The local Chief, Sub-chiefs, was used to mobilize the public to attend the meetings. The announcements for the meetings were made by phone calls, announcement at centres and settlements, in places of worship and Chiefs' barazas.

1.7.7 Socio-economic/Household survey in Kimilili Town

A total of 343 Household Socio-economic survey questionnaires were administered within the proposed project areas to assess the socio-economic status of the project area.

1.7.7.1 Data Collection Tools

The socio-economic survey used both the quantitative and qualitative tools. Three quantitative tools namely; household survey questionnaire, education institutions questionnaire and health institution survey questionnaire were used. Qualitative tools included; Waste handlers guide and Industries guide. Samples of both quantitative and qualitative tools are appended in this report.

1.7.7.2 Digitization of Data Collection Tools

An Open Data Kit (ODK) collect server subscription was secured until data collection was completed and beyond. The household survey questionnaire, education and health survey questionnaires developed in word format were coded in to digital format using the (ODK) coding language. The coded survey forms were pre-tested and improved further before deployment for field data collection.

The figure below explains how digital data collection works. The process is designed to allow feedback loops. The starting point is the design/coding of the questionnaire. In ODK this can be done using the online inter-phase or through spreadsheets. The later was used for this exercise. The forms were then sent to the server ready for download to the mobile data collection devices.

1.7.7.3 Mobile Data Collection Process

Data collection used android-based devices from version 7.0 and above. The ODK collector application/inter-phase was installed in the gadgets. The gadgets were configured with the correct credentials for data collection. This enabled the enumerators to access the server and download the forms and upload/submit the completed interviews in real time. The submitted data was used to communicate data quality issues to field teams and also improve any technical data collection issues identified in the forms.

1.7.7.4 Data analysis, reporting and documentation

Upon data analysis, potential environmental impacts (both positive and adverse) were predicted based mainly on concerns raised by the public, stakeholders and expert observations on the ground and available tools. The magnitude, significance, and acceptability of predicted impacts were evaluated with a view to determining whether observed adverse impacts are significant enough to warrant mitigation. Impacts were further screened for occurrence and significance of residual (those which cannot be mitigated satisfactorily) and cumulative impacts with a view to providing a basis of making recommendations on the way forward for the project.

1.8 Terms of Reference

The following broad terms of reference applies to the project:

- Description of the proposed location of the project;
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project;
- The objectives of the project;
- The technology, procedures and processes to be used, in the implementation of the Project;
- The materials to be used in the construction and implementation of the project;
- The products, by-products and waste generated by the project;
- A description of the potentially affected environment;
- The environmental effects of the Project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated;

- Alternative technologies and processes available and reasons for preferring the chosen technology and processes;
- Analysis of alternatives including project site, design and technologies and reasons for preferring the proposed site, design and technologies;
- An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, time frame and responsibility to implement the measures;
- Provision of an action plan for the prevention and management of foreseeable accidents and hazardous activities in the course of carrying out activities or major industrial and other development projects;
- The measures to prevent health hazards and to ensure security in the working environment for the construction workers in case of emergencies;
- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information;
- An economic and social analysis of the project;
- An indication of whether the environment of any other state is likely to be affected and the available alternatives and mitigating measures; and
- Such other matters as the Authority may require.

1.9 The Environmental Impact Assessment Team

The table below presents the Environmental Impact Assessment team for the project:

Table 1-2: ESIA Project Team

Name	NEMA Reg. No.	Responsibilities
Charles Lwanga Muyembe	Lead Expert Reg. No 1283	Team Leader, Policy review, Flora, Fauna and Community sensitization
Julius Musyoka Musili	Lead Expert Reg. 3074	Project review, liaisons, quality assurance, and Community sensitization.
Jason Opanda	NEMA Associate Expert No. 8304	Site survey, data collection and report writing
Florence Muthui	NEMA Expert Reg. 8703	Social economic analysis, data collection , report writing
Evelyn Mbithi	Sociologist	Social economic analysis, data collection , report writing

2 PROJECT DESCRIPTION

2.1 Project Background

NZOWASCO's sewerage treatment plants exist in three regions namely Bungoma, Webuye and Kitale regions. In Kitale the company operates two sewerage treatment systems. The convectional system located at Matisi and lagoon system located at Bidii. The major source of waste water includes municipal sewerage, industrial sewerage, storm water and urban runoff.

The following points highlight the current sanitation situation in Kimilili Town:

- Currently, there is no existing water borne sewerage system serving Kimilili town;
- The population of Kimilili relies on VIP latrines, septic tanks and pit latrines for disposal of waste. These facilities are also very few due to existing high water tables within and around Kimilili Town. When these facilities are filled up, they exhaust and discharge using private lorries to designated treatment works in Bungoma or Webuye. However, some people resort to exhausting of the wastes manually at night and dispose the same into open drains leading the waste to Kimilili river;
- The sanitation problem is compounded by lack of exhauster services which are only available in Kakamega town, 60km away from Kimilili;
- Some people throw human waste into refuse pits using polythene bags at night;
- The wastewater from washing areas also stagnates along the road due to lack of proper drainage system and as a result springs and wells are polluted by underground seepage from toilets. This situation has inadvertently led to the upsurge of water borne diseases which are directly or indirectly linked to poor wastewater management such as cholera.

The Proposed development of Kimilili sewerage system will involve establishment of new sewer lines and wastewater treatment facilities; the extent of the proposed project is within Kimilili town and its environs.

2.2 Sewer Network Layout

The main catchments within Kimilili Town were generated using GIS-based hydrological analysis techniques, giving an indication of the overall drainage regime of the area as per the figure below:

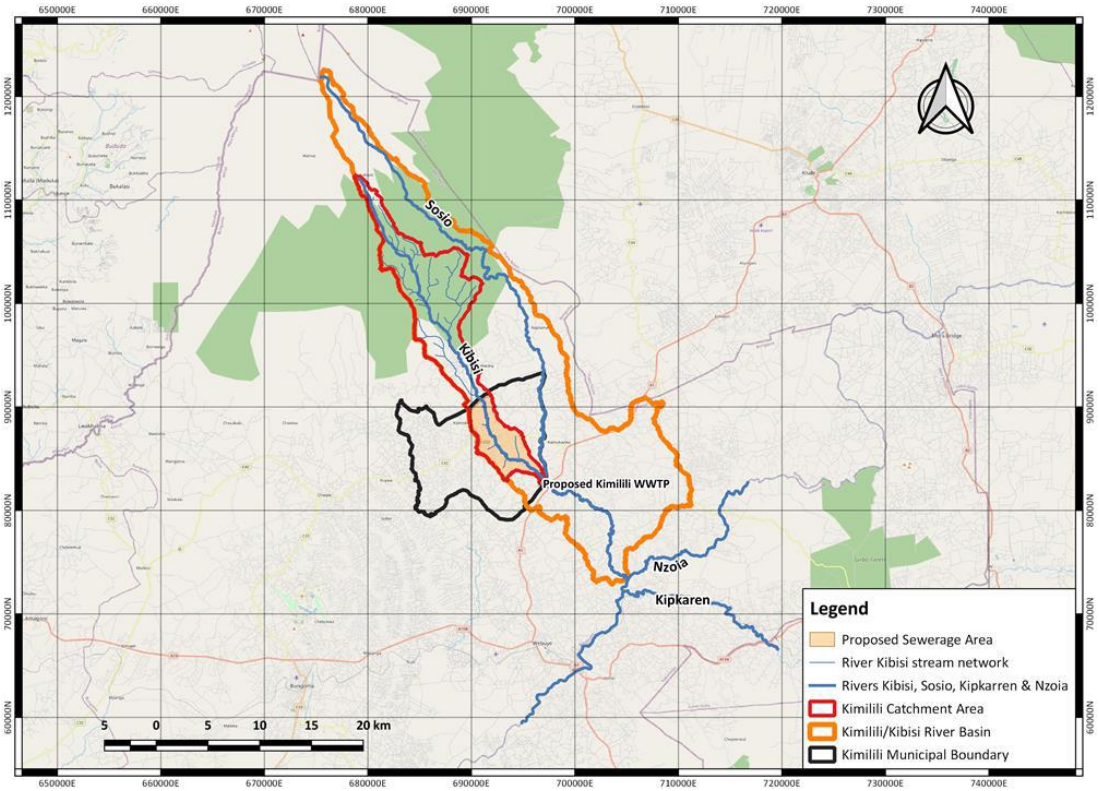

Figure 2-1: Proposed Sewerage Drainage areas within the Kimilili Town catchment area

The figure below presents the proposed sewer network for Kimilili Town area:

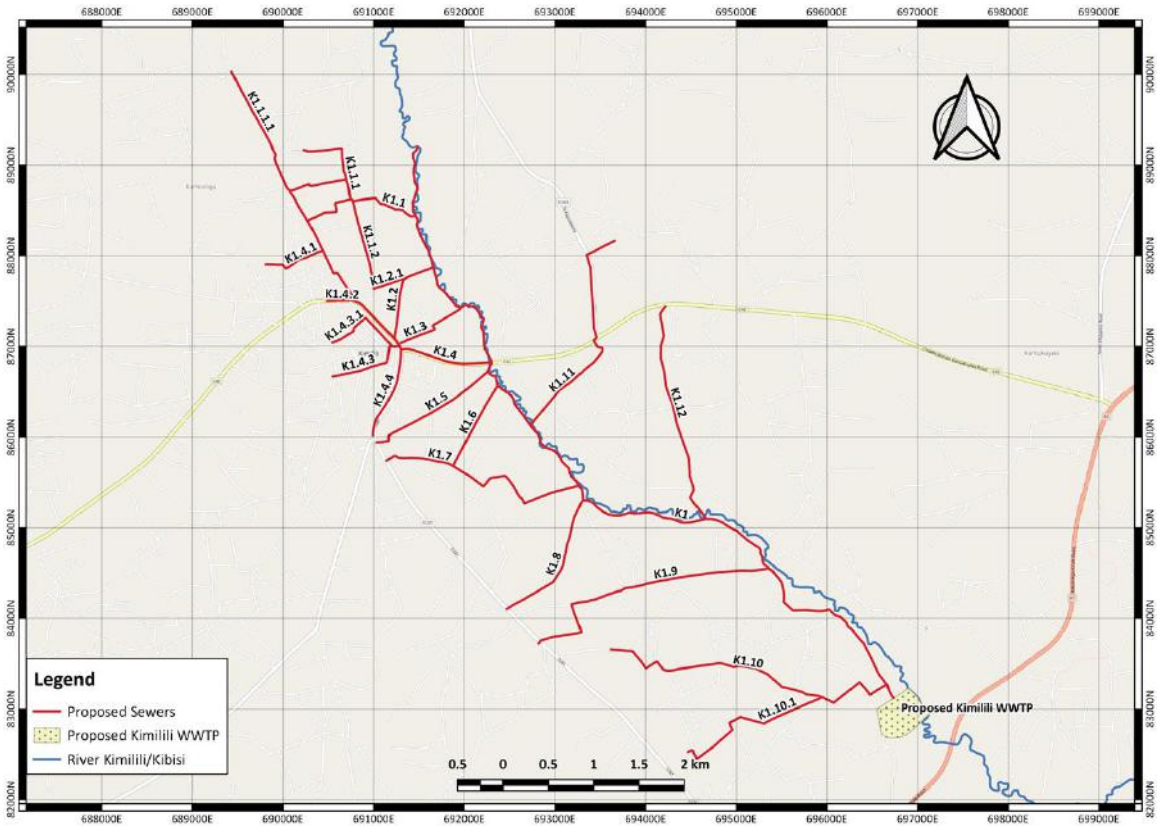

Figure 2-2: Proposed sewer network layout for Kimilili Town and environs

2.3 Proposed Sewers

The proposed Kimilili Town Sewerage project has one main trunk sewer namely K_1 as shown in *Error! Reference source not found.* above. The description of the trunk sewer system is as follows:

The proposed K1 trunk main sewer originates from Kamusinga area, north of Kimilili Town Centre. It traverses the banks of River Kibisi, with two major paved road crossings on Kimilili – Kapsokwony Rd and Kimilili – Kamukuywa Rd. It then discharges wastewater effluent to the proposed Kimilili Wastewater Treatment Plant located to the south east of Kimilili Municipality, near the A1 Kakamega – Kitale Road. The sewer will serve the areas of Kamusinga, Kimilili town centre, Kimilili market, Jonaf Farm, Khamulati, Kimilili – Kamukuywa Rd., Kimilili – Kapsokwony Rd, areas along the banks of River Kimilili/Kibisi, Matili TTI and Maeni areas. The specific drainage areas to be served within this catchment include Moi Girls Kamusinga, Friends School Kamusinga, CBSM Kimilili School, Kory Family Hospital Kimilili, Kimilili Bus Stop, Banks, Shops, Offices and institutions within the CBD, Western Province Police Training College, Kimilili Sub County Hospital, Matili Technical Training Institute, Kimilili Market, Kamtiong Market and Maeni area. The trunk will therefore serve a huge proportion of the town.

The K1 trunk sewer will receive wastewater flows from secondary sewers K1.1, K1.2, K1.3, K1.4, K1.5, K1.6, K1.7, K1.8, K1.9, K1.10, K1.11 and K1.12. Secondary sewer K1.1 has three lateral sewers discharging into it, namely K1.1.1, K1.1.1.1 and K1.1.2; K1.2 has one lateral sewer K1.2.1 discharging into it; K1.4 has lateral sewers K1.4.1, K1.4.2, K1.4.3, K1.4.3.1 and K1.4.4; and K1.10 has one lateral sewer K1.10.1.

The table below shows the summary of the proposed sewers within the proposed trunk sewer M_1.

Table 2-1: Summary of the proposed sewers to serve the proposed trunk sewer K_1

Trunk Sewer	Secondary Sewer	Lateral Sewer
K1	K1.1	K1.1.1
		K1.1.1.1
		K1.1.2
	K1.2	K1.2.1
	K1.3	-

Trunk Sewer	Secondary Sewer	Lateral Sewer
	K1.4	K1.4.1
		K1.4.2
		K1.4.3
		K1.4.3.1
		K1.4.4
	K_1.5	-
	K_1.6	-
	K_1.7	-
	K_1.8	-
	K_1.9	-
	K1.10	K1.10.1
	K1.11	-
	K1.12	-

The table below presents the detailed design details of the proposed sewers:

Table 2-2: Hydraulic Design of proposed sewers for Kimilili Town

Proposed Sewer	Length (m)	Pipe Diameter (mm)	Pipe Material
K1	9,391.70	300 – 375 – 450 – 525 - 600	PCC
K1.1	1,391.80	200	DWC
K1.1.1	994.50	200	DWC
K1.1.1.1	2,134.50	200	DWC
K1.1.2	971.00	200	DWC
K1.2	997.10	200	DWC
K1.2.1	342.40	200	DWC
K1.3	832.90	200	DWC
K1.4	3,201.40	200 - 250	DWC
K1.4.1	700.80	200	DWC
K1.4.2	331.70	200	DWC
K1.4.3	907.00	200	DWC
K1.4.3.1	901.00	200	DWC
K1.4.4	1,008.80	200 - 250	DWC
K1.5	1,499.10	200	DWC
K1.6	1,013.10	200	DWC
K1.7	2,470.30	200	DWC
K1.8	1,561.20	200	DWC
K1.9	3,069.70	200	DWC
K1.10	3,493.30	200	DWC
K1.10.1	2,107.70	200	DWC
K1.11	2,649.70	200	DWC/Steel
K1.12	2,487.50	200	DWC/Steel
Total Length	**44,458.20**		

2.4 Proposed Wastewater Treatment Plant

2.4.1 Overview

From the analysis undertaken during Feasibility Study and Preliminary Design phases, a hybrid system of wastewater stabilization ponds and trickling filters was found to be the most suitable wastewater treatment option for Kimilili Town.

Wastewater stabilization ponds are large, shallow ponds in parallel or series that allow for the wastewater to be treated in a natural manner through processes involving bacteria and algae, and solar UV radiation. The processes are most efficient at higher temperatures; hence they are a very preferred treatment method in tropical countries.

From literature, it can also be confirmed that in case land availability is not a concern and climate is sufficiently warm, waste stabilization ponds are often the most preferred and suitable method of wastewater treatment. They require

relatively large areas of land to provide the necessary long retention periods needed to stabilize the organic material in the wastewater, but on the other hand, they operate without mechanical equipment (if gravity flow can be assured) and with limited supervision. Furthermore, the systems maintenance requirements are minimal.

Waste stabilization ponds are without doubt the most important method of wastewater treatment in developing countries where sufficient land is normally available and where the temperature is most favourable for their operation.

There are three principal types of WSP: anaerobic, facultative and maturation ponds. Anaerobic ponds and facultative ponds are designed for BOD (biochemical oxygen demand) removal, and maturation ponds are designed for faecal bacterial removal.

The different WSP types are arranged in a series – first an anaerobic pond, then a facultative pond, and finally (and if needed to achieve the required effluent quality) one or more maturation ponds. At any one site there may be more than one series of WSP, each usually receiving an equal proportion of the wastewater flow.

It is commonly observed that the effluent from a series of ponds is of better quality than that from a single pond of the same size. This is because, even if the hydraulic flow regime in individual ponds is closer to complete mixing than it is to plug flow, the overall performance of a series of ponds.

Trickling filters are a valuable alternative for natural wastewater treatment in case land availability is limited and operator capacity is sufficiently high to operate the slightly more complex system in an efficient way.

A trickling filter is a three-phase system with fixed biofilm carriers. Wastewater enters the bioreactor through a distribution system, trickles downward over the biofilm surface, and air moves upward or downward in the third phase. Trickling filter components typically include a distribution system, containment structure, rock or plastic media, underdrain, and ventilation system.

Just as waste stabilization ponds systems, trickling filters (TFs) are used to remove organic matter (BOD) from wastewater. The TF is a system that functions under (mostly) aerobic conditions and utilizes microorganisms attached to a medium (rocks or plastic) to remove organic matter from wastewater. These systems are known as attached-growth processes. In contrast, systems in which microorganisms are sustained in a liquid are known as suspended-growth processes (EPA, SWMM).

Table 2-3: Brief factsheet of trickling filters (SWMM)

Working Principle	Wastewater trickles vertically through a porous media (e.g. a stone bed) with high specific surface. The biofilm growing on the media removes organic matter under aerobic conditions.
Capacity/Adequacy	Semi-centralised to centralised. The system is usually applied in urban areas for treatment of domestic wastewater. It can be applied for bigger and smaller communities.
Performance	BOD: 65 to 90 %. Low TSS removal. Total Coliforms: 1 to 2 log units N: 0 to 35%. P: 10 to 15 %.
Costs	Medium; investment costs depend on type of filter materials and feeder pumps used; operational costs determined by electricity consumption of feeder pumps.
Self-help Compatibility	Low. Design, planning and implementation by expert consultants; no community labour contribution possible; feeder pumps required; permanent staff required for operation.
O&M	Civil engineer needed for construction, professional service providers required
Reliability	Resistant to shock loadings but the systems do not work during power failures in case reliant on feeder pumps.
Main strength	High treatment efficiency with lower area requirement compared to wetlands or ponds; resistant to shock loading.
Main weakness	Requires expert skills, pumps and continuous electrical power, as well as ample and continuous wastewater flow required

Since development of the proposed wastewater treatment plant will be phased, the recommendation was to construct the waste stabilization ponds in Phase 1, then expand the WWTP by adding trickling filters during Phase 2. This will have the following advantages:

- It will reduce the land requirements since trickling filters do not require large areas of land compared to waste stabilization ponds;
- It will allow for time for operational capacity building within the water service provider's team;
- It will allow for additional buffer in case the trickling filter experiences some technical problems – the facultative ponds from the Phase I works will be there to still offer a reasonable (not perfect) level of treatment.

2.4.2 Location of the Proposed Wastewater Treatment Plant

A number of potential sites/locations for the proposed wastewater treatment plant were analysed, mainly based on the following conditions:

- Availability of land;
- Topography that should allow for gravitational flow of the sewer collection system as much as possible.

In addition to those two main conditions, there are a number of other important issues that were considered in choosing the location of the proposed Wastewater Treatment Plant:

- The available area, topography, and soil conditions of the site should be suitable for the construction of the type of plant proposed;
- The chosen location should not be susceptible to flooding;
- The chosen location should not be too far from the main contributing areas;
- The chosen location should be close to the final point of effluent disposal;
- The location should preferably be close to water supply, electricity services and access roads.

It should be noted that it is very rare to find a wastewater treatment location that fulfils all the requirements of an ideal treatment site and, often compromises need to be made. With pond systems, in particular, it is sometimes difficult to find a suitable site that has a large enough land area.

The proposed site for the Kimilili WWTP is located at Sango area, near the confluence of Rivers Kimilili/Kibisi and Sosio and on the south eastern side of the Kimilili Municipal boundary, near the Kakamega – Kitale highway. The proposed site is located in the lowest part of the catchment area, predominantly covered by the clay loams that are well drained and do not absorb much water. However, the Consultant concluded geotechnical investigations and testing to ascertain the parameters of the soils in the area. The soils were found to be inadequate and lining of the waste stabilization ponds was recommended and Concrete and HDPE liners were proposed.

The table below shows the assessment undertaken for the proposed wastewater treatment plant site:

Table 2-4: Analysis of the proposed WWTP location in Kimilili Town

Criteria	Kimilili WWTP
At least 200m (preferably 500m) downwind from the community	No – away from the more densely populated areas, but still quite a number of houses and farms within the 200 m radius. The wind blows lightly from western directions.
Drainage	Good drainage location – most of Kimilili Town and environs can drain to the site by gravity flow. It is located at the lowest point of the Kimilili town catchment.
Away from any likely area of future expansion	Yes – located in peri-urban area dominated by households and farmland.
Vehicle access available	Yes – murram and tarmac road connectivity. Located near the Kakamega – Kitale road.
Site should be flat or gently sloping	Yes – the area is gently sloping towards the river as confirmed on site during topographic survey.
Soils must be suitable (NOT organic / plastic / medium-to-course sand)	Soils were confirmed to be inadequate and unsuitable after concluding geotechnical investigations and testing. Thus Concrete and HDPE liners proposed.
Not located within 2 km of airports	Yes – no airstrip/airport in Kimilili Town
Groundwater table	In areas of the Basement System with deep soil cover most wells seemed to be successful at moderate depths, due probably to the tapping of indicating a shallow water table – therefore, lining of the ponds was recommended to avoid inflow.
Proximity to a receiving water body (stream, river, lake, ocean).	Yes – adjacent to River Kimilili/Kibisi

Estimation of Peak Flood Discharge for a desired return period is a pre-requisite for planning, design and management of wastewater treatment plants. As mentioned above, the proposed site of the WWTP should not be susceptible to flooding. The system must be protected from general flooding, for ponds, inlet and outlet devices, and other features

can be damaged or destroyed by floodwaters and accompanying debris. Floodwaters containing large amounts of sediments may, through deposition and erosion, completely destroy inadequately protected waste stabilization ponds.

Therefore, flood analysis of the proposed site was undertaken to establish the level of flood resilience of the proposed infrastructure. The analysis was undertaken using HEC-RAS software which is a suitable tool for performing one-dimensional steady flow, one and two-dimensional unsteady flow calculations, sediment transport/mobile bed computations, and water temperature/water quality modelling.

River Gauge Station (RGS) data for River Kimilili/Kibisi was obtained from Water Resources Authority (WRA), Kakamega Office, and terrain information was obtained from the topographical surveys undertaken by the Consultant. From these inputs, a flood frequency analysis was undertaken using different methods to predict the magnitude of 10, 25, 50 and 100-year flood discharges. The peak flood values for the different Return Periods are very useful for storm/flood management in water and wastewater treatment infrastructure.

The Consultant adopted two probability distribution methods used to model the river flows, namely Gumbel method and Log Pearson method. The methods were used to model the annual maximum discharge of the River Kimilili/Kibisi at the proposed Kimilili WWTP site, for a period of 8 years (1960 to 1968). The following results were obtained:

Table 2-5: Flood Frequency Prediction using Gumbel's and Log Pearson's Models

Return Period, T	Probability of Exceedance, P	Design Flow Qd (m^3/s)	
		Gumbel	Log Pearson
10	0.1	3.29	2.39
25	0.04	4.23	3.62
50	0.02	4.93	4.98
100	0.01	5.62	6.86

The 50yr and 100yr design floods were then adopted for the flood modelling in HEC-RAS. The figure below illustrates the output of the simulation.

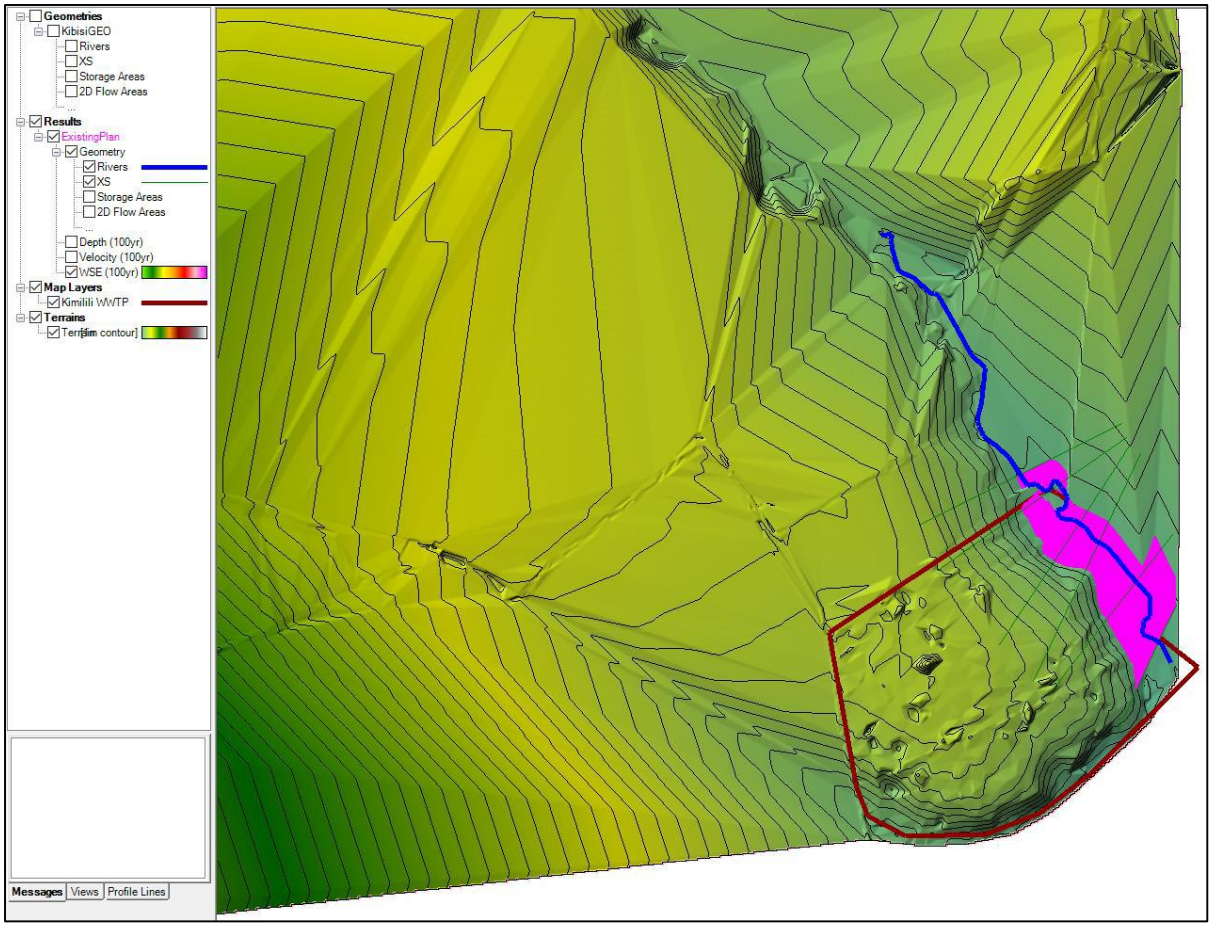

Figure 2-3: Output of flood modelling in HEC-RAS Mapper

A number of cross-sections were considered across the river to determine the water surface level for both 50yr and 100yr floods. The figure below shows the water surface levels of the cross-sections for the selected design floods.

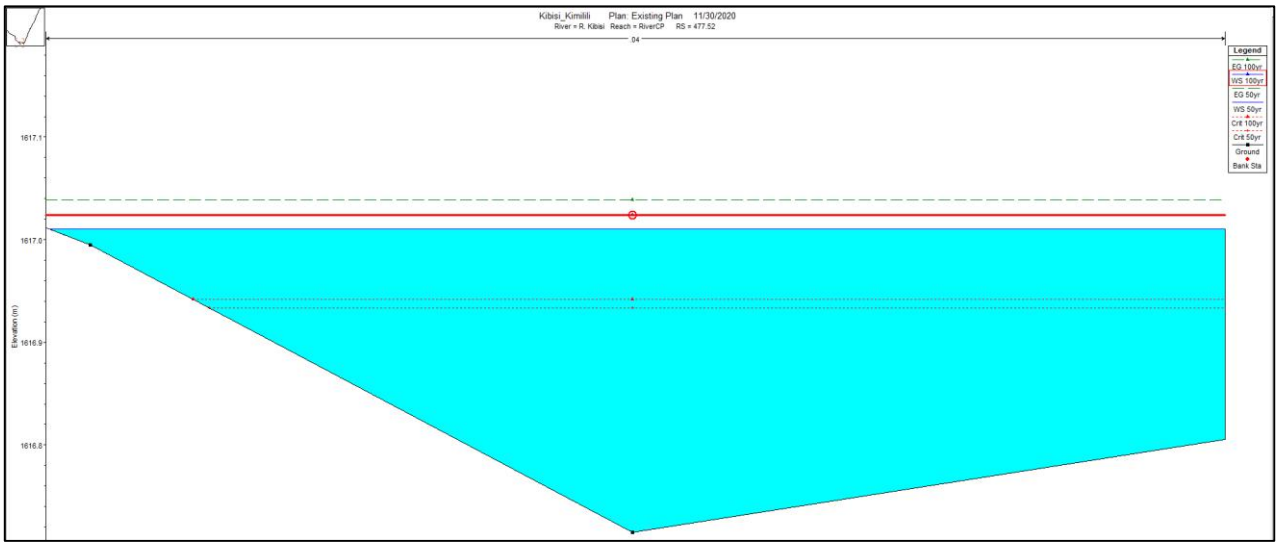

Figure 2-4: Water Surface Level of River Station 477.52 adjacent the proposed Kimilili WWTP site.

From the figure above, it can be seen that the water surface level is at the 50yr design flood level, but below the 100yr design flood level (red line). In essence, this means that if the 100yr flood event occurs, the wastewater treatment infrastructure will not be flooded. The floodplain is located downstream of the proposed wastewater treatment infrastructure and therefore no threat of flooding.

2.4.3 Design Wastewater Flows

Conventionally, it is most economical to design the wastewater treatment plant for the service and flows expected at full buildout of the drainage areas. However, the cost of such infrastructure in areas that remain sparsely populated can be significant, and much of the loading may not be realized for many years. This results in trade-offs between budget limitations and the desire to provide ultimate capacity.

Therefore, the approach for the WWTW design is that wastewater treatment works will be phased based on the design horizons and respective wastewater flows as below:

- Phase I – 2035 flows;
- Phase II – 2045 flows (Full buildout).

Table 2-6: Estimated wastewater flows towards the Kimilili WWTW

Wastewater Flows (m^3/day)	2035 (Phase 1)	2045 (Phase 2)
Computed Flows	3,537	4,709
Design Capacity	3,600	5,000

From the table above, the proposed Kimilili WWTP capacity will be 3,600m^3/day for Phase 1 (2035 horizon) and expanded to 5,000m^3/day for Phase 2 (2045 horizon). The Peak Factor of 2 was adopted in line with the recommendations of the Kenya Ministry of Water, Sanitation Final Practice Manual for Sewerage and Sanitation Services.

2.4.4 Process Design

The proposed hybrid system comprises waste stabilization ponds and trickling filters to produce high quality effluent of BOD < 30 mg/l, Suspended Solids < 30 mg/l and Coliform count < 1000 per 100ml.

The figure below illustrates the process flow diagram for the proposed wastewater treatment system:

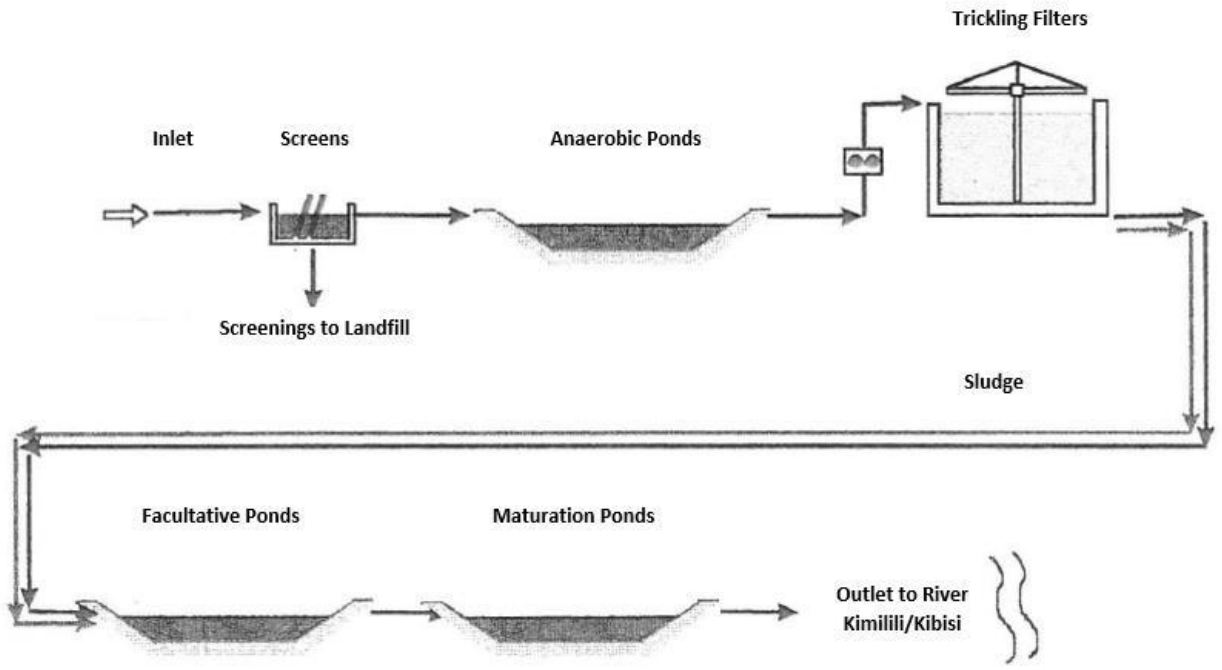

Figure 2-5: Process Flow Diagram (PFD) for the Proposed Kimilili WWTP

For the waste stabilization ponds process design, the faecal coliform and helminth egg removal was determined as per below table:

Table 2-7: Faecal Coliform and Helminth Egg Removal

Parameter	2045
Faecal Coliform Removal	985 per 100ml
Helminth Egg Removal	0.29 egg/l (99.99% removal)

The overall BOD removal in the Kimilili waste stabilization ponds + trickling filter system is estimated as follows:

Table 2-8: Overall BOD efficiency of Kimilili WWTP

BOD Load (mg/l)	2045	BOD Removal Efficiency (%)
Load at entry to the anaerobic ponds	350	56.8
Load at entry to the trickling filter	151.2	74.2
Load at entry to the facultative ponds	60	87.3
Load at entry to maturation ponds	15	-
Load at exit	15	-

2.4.5 Physical Design

The WSP process design was translated into a physical design with actual pond dimensions consistent with the available site, embankments and pond inlet and outlet structures. The number of parallel pond series to have was determined and a decision whether or not to line the ponds made based on the findings of geotechnical investigations. By-pass pipework, security fences and notices, and operator facilities are provided.

The physical design of the waste stabilization ponds was carefully undertaken to ensure a high level of wastewater treatment efficiency and effluent quality as per prescribed design and effluent criteria.

The following section presents the physical design of the proposed waste stabilization ponds for both Phases 1 & 2:

Table 2-9: Design of Anaerobic Ponds

Design Parameter	2035 (Phase 1)	2045 (Phase 2)
Number of ponds	3	3– **remains the same**
Top Length (m)	50	50
Top Width (m)	32.5	32.5

Design Parameter	2035 (Phase 1)	2045 (Phase 2)
Bottom Length (m)	25	25
Bottom Width (m)	7.5	7.5
Pond depth (m)	4.0 (2.5m water + 1.5m sludge)	4.0 (2.5m water + 1.5m sludge)
Freeboard depth (m)	1	1
Length to breadth ratio	2:1	2:1
Embankment slope H/V	2.5:1	2.5:1
BOD removal efficiency (%)	56.8	56.8
Top surface area of ponds (m^2)	4,850	4,850– **remains the same**
Retention time (days)	2	1.31

Table 2-10: Design of Facultative Ponds

Design Parameter	2035 (Phase 1)	2045 (Phase 2)
Number of ponds	2	2 – **remains the same**
Top Length (m)	163.5	163.5
Top Width (m)	85.5	85.5
Bottom Length (m)	148.5	148.5
Bottom Width (m)	70.5	70.5
Pond depth (m)	1.5 (1m water + 0.5m sludge)	1.5 (1m water + 0.5m sludge)
Freeboard depth (m)	1	1
Length to breadth ratio	2:1	2:1
Embankment slope H/V	3:1	3:1
Incoming BOD load (mg/l)	151.2	60
BOD removal efficiency (%)	74	53
Top surface area of ponds (m^2)	28,000	28,000– **remains the same**

Table 2-11: Design of Maturation Ponds

Design Parameter	2035 (Phase 1)	2045 (Phase 2)
Number of ponds	2	2 – **remains the same**
Incoming Faecal Coliform Load (FCU/100 ml)	288,763	288,763
Effluent Faecal Coliform Load (FCU/100 ml)	608	985
Top Length (m)	278	278
Top Width (m)	74	74
Bottom Length (m)	270	270
Bottom Width (m)	64	64
Depth of Pond (m)	1.0	1.0
Freeboard depth (m)	0.5	0.5
Top surface area of ponds (m^2)	40,700	40,700– **remains the same**
Retention time per pond (days)	8	6

Table 2-12: Design of Trickling Filters

Design Parameter	Value
Number of Trickling Filters	2
Design Temperature (T) (°C)	18.4
Modified rate constant (K_T) (m/day)	0.048
Average flow per filter (Q) (m^3/day)	2500
Incoming BOD (L_i) (mg/l)	151.2
Outgoing BOD (L_e) (mg/l)	60
BOD removal efficiency low rate TF (%)	87
Organic/BOD loading rate (kg/m^3/day)	0.354
Hydraulic loading rate (m^3/m^2/day)	3.0
Recirculation rate	0
Filter Media surface area (S) (m^2/m^3)	45

Design Parameter	Value
Filter Volume (m^3)	1,068
Filter Surface (m^2)	356
Filter Diameter (m)	22
Filter Depth (m)	3
Retention Time (θ) (days)	1
Dosing Rate for the filter (mm/pass)	Operating dose – 50 Flushing dose - 100
Oxygen Transfer (O_2/kg BOD applied)	46.52
Airflow (AR_{STD}) (m^3/min)	87.4
Corrected air flowrate for temp. and pressure (AR_{26}) (m^3/min)	95.8
Corrected air flowrate for lower oxygen saturation (AR) (m^3/min)	101.5
Head loss/Pressure Drop (Pa)	0.0023
Natural draft pressure (Pa)	0.3430
Electrical energy for daily flow (kWh/day)	136
Distributor speed (rev/min)	Normal operation - 0.0104 Flushing - 0.0052

The following table shows the land requirements for the proposed wastewater treatment infrastructure for Phases 1 and 2:

Table 2-13: Kimilili Waste Stabilization Ponds + Trickling Filter Land Requirement Estimate Summary (exact measurements rounded)

Design Horizon & WWTP Capacity	Components	Number	Retention Time (Days)	Surface Area (m^2)	Total Area (m^2)
2035 flow – 3,600 m^3/day	Anaerobic ponds	3	2	1,610	4,850
	Facultative ponds	2	10.36	14,000	28,000
	Maturation ponds	2	8	20,350	40,700
	Sludge drying beds			2,700	2700
	TOTAL PONDS AREA				**76,250**
	Allow for additional land around ponds - ponds make up 60% of required area				50,834
	TOTAL LAND REQUIREMENT				**127,084**
2045 flow – 5,000 m^3/day	Anaerobic pond	3	1.44	1,610	4,850
	Trickling filters	2	0.4	900	1,800
	Facultative pond	2	7.4	14,000	28,000
	Maturation pond	2	4.9 + 4.9	20,350	40,700
	Sludge drying beds			3,700	3700
	TOTAL PONDS AREA				**79,050**
	Allow for additional land around ponds - ponds make up 60% of required area				52,700
	TOTAL LAND REQUIREMENT				**131,750**

Table 2-14: Design of Sludge Drying Beds

Parameter	Value
Population equivalent at 108 LPCD waste	33,333
Anaerobic pond sludge volume	0.04 m^3/capita/year
Total anaerobic pond sludge volume	1,333.33 m^3/year
Sludge volume provided in all anaerobic ponds	1414.36 m^3
Cleaning required period	1 year
Application layer of sludge	0.5 m
Area of Sludge Drying Beds	2700 m^2 – 2035 Horizon (4Nr. @ 32m by 21m) 3700 m^2 – 2045 Horizon (2Nr. @ 32m by 21m)

2.4.6 Onsite Wastewater Treatment Facilities

Most of the areas within the Kimilili town will be served by the proposed sewerage system. However, it will not be possible to serve some areas in the immediate term, thus the Consultant has proposed ablution blocks and septic tanks for these areas. The areas could later be connected to the sewerage system through a phased approach.

2.5 Proposed Project Activities

2.5.1 Construction phase activities

The proposed sewer system will consist of localized activities in the specific areas that are marked for the activity. The project is designed to follow the existing water supply pipe network that is already operational in Kimilili town. The project activities during construction phase will involve:

- Surveying, setting out and demarcation of the pipe network lines;
- Supply and installation of sewer pipes;
- Stripping top soil;
- Excavation and shoring;
- Disposal of excavated material;
- Backfilling of pipe trenches thereafter and cementing of new pipes to the respective pipeline ancillaries.

2.5.2 Materials and equipment for the proposed project

The sewers construction will involve the use of the following materials;

- Double Wall Corrugated (DWC) HDPE and Precast Concrete (PCC) pipes;
- Survey equipment;
- Excavation equipment;
- Vehicles including dumper tippers;
- Micro tunnelling equipment;
- Epoxy coated steel pipes and sleeves.

2.5.3 Site safety and Environmental considerations

The Contractor is required to ensure so far as is reasonably practicable and to the satisfaction of the supervising engineer; that the impact of the construction on the environment is kept to a minimum and that appropriate measures as outlines in the EMP are implemented to mitigate any adverse effects during the construction. Some of the key measures are:

- The project active sites be enclosed with reflective barrier materials including reflective cones and tapes to prevent intrusion by the public;
- A safe system of work be provided by the consultant for the proposed work activities;
- Casual workers identified be inducted on safe methods of work and tool box meetings provided daily;
- All workers be provided with appropriate safety wear which they must use while at work.

The table below shows the various type of products, by products and waste that will be generated during the project's cycle.

Table 2-15: The products, by products and waste generated during project cycle

Project Activities	Material /Equipment to be used	Waste/By Products Generated	Disposal Method
1. Planning and design Phase – No anticipated physical activities or processes			
2. Construction Phase			
Clearing the site	• Power Saws • Caterpillar/ Shovel	• Cut vegetation • Rock debris • Noise (by power saw)	• Soil to be used for backfilling • Wood would be used as fuel and in the construction. • Good maintenance of machines being used.
Excavation/Earthworks including removal topsoil	• Excavation equipment's including caterpillars, haulers etc.	• Soil • Roots • Noise	• Soil to be used for backfilling and landscaping.

Project Activities	Material /Equipment to be used	Waste/By Products Generated	Disposal Method
Transportation materials maintenance equipment	• Trucks • Fuel, spare parts and lubricants oil	• Fumes • Used oil, and other lubricants.	• Used oil/grease to be reused for lubricating movable parts of • Equipment.
Construction/Building Materials	• Machine cut stones • Steel • Cement • Soils • Timber • Nails, galvanized iron sheets • Gravel, sand • Glass	• Stone /Rock Debris • Timber Splits • Broken Glass • Nails and Iron Sheets • Cuts • Piping Remains • Plastic Waste • Oil and Greases Spills • Waste Water • Used Containers	• Soil and rock debris would be used for landscaping & back filling the reserves • Timber splits would be used for firewood • Plastic waste should be resold to waste collectors or dumped in appropriate designated sites.
	• Water • Packaging • Materials • Pipes and PVC • Oil and Grease • Storage • Containers e.g. Drums		• Metallic containers can be reused in storage of other materials or be sold to dealers. • Metallic wastes can be recycled or be sold to dealers. • Waste water can be recycled by watering diversions to control dust. • Oils and grease should be reused, be sold to dealer or be disposed off in areas.
Human Consumables	• Stationeries • Computers • Photocopiers • Clothing Materials • Vehicles • Medicines • Reagents • Food and Water	• Used paper • Obsolete/ spoilt clothing, computers, photocopiers and • Vehicle parts • Human waste • Expired drugs and reagents	• Sell waste paper to dealers. • All obsolete materials should be carefully sorted, stored and sold to dealers. • Septic tanks should be provided in all the workmen's camps and disposed of appropriately in designated sites.

3 BASELINE INFORMATION OF THE PROJECT AREA

3.1 Project Location

Kimilili Municipality is situated in Western Kenya in Bungoma County on Latitude are 0° 47' 0" North of Equator and 34° 43' 0" East of Greenwich Meridian on the slopes of Mt. Elgon. Nationally, the Municipality is approximately 327Km North West of Nairobi City, the capital of Kenya. The presence of A1 international trunk traversing the centre links the area to other regional towns and the rest of the world.

Kimilili town is located in Bungoma County in Western Kenya bordering Uganda to the North-West, Trans Nzoia County to the North-East, Kakamega County to the East and South-East, and Busia County to the West and South-West. Kimilili is home to the Western Provincial Police Training Centre.

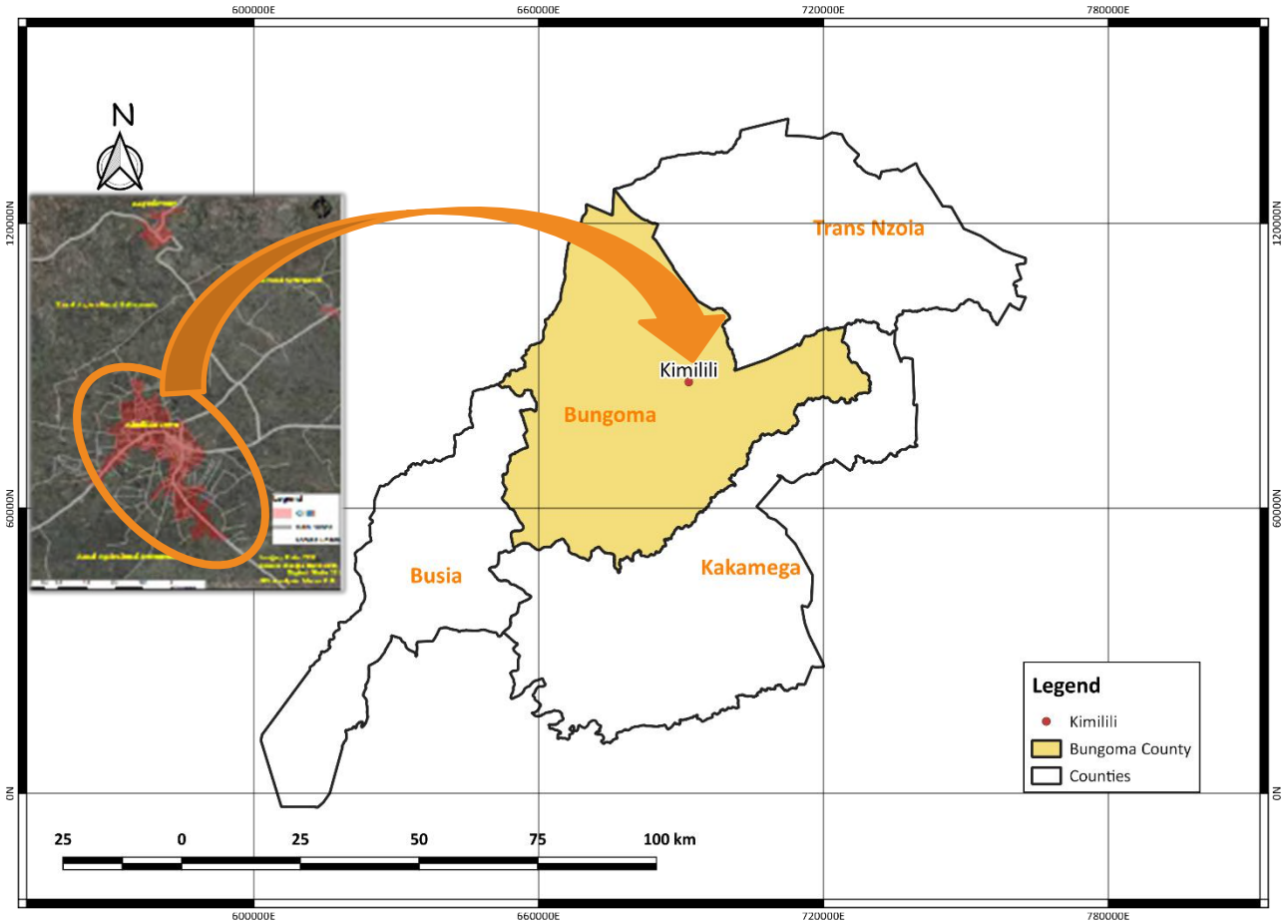

Figure 3-1: Location of Kimilili Town

Kimilili Municipality is located in Kimilili Sub-County which is one of the nine sub-counties in Bungoma County. The sub-county borders Mt. Elgon, Tongaren, Webuye East, Webuye West and Kabuchai Sub counties. Regionally, the town is linked to Bungoma Kitale, Kapenguria, Eldoret, Nakuru and Kisumu towns via a vast interconnected transport networks mainly A1 Road.

Kimilili Municipality is located along the Chwele – Kamukuywa transport corridor. The town serves as the sub-county headquarters for Kimilili Sub-County. The sub-county has four wards namely Kamukuywa, Maeni, Kimilili and Kibingei wards. The planning area covers parts of Maeni Kibingei and Kimilili wards.

3.2 Administration

3.2.1 Kimilili Town

Kimilili Municipality is under the jurisdiction of Bungoma County, Kimilili Sub County. The planning area covers parts of three (3) electoral wards in the sub-county namely Kibingei, Maeni and Kimilili. At a lower level, Kibingei ward is divided

into two Sub locations i.e. Chebukwabi and Kibingei, Maeni ward into Nasusi and Sikhendu Sub locations and Kimilili ward into township and Kimilili Sub location.

Table 3-1: Kimilili Municipality Administrative units

Ward	Sub Locations	Area Sq. Km
Kibingei	Chebukwabi	51.64
	Kibingei	
Maeni	Nasusi	40.81
	Sikhendu	
Kimilili	Township	41.95
	Kimilili	

Source: IEBC Boundary delineation report 2013

3.2.2 Structuring elements

The key structuring elements in Kimilili include main transport routes such as Kimilili - Chwele-Kamukuywa –Kitale and Kimilili-Bungoma roads; Rivers Sosio, Kibisi and Kibingei and rich agricultural lands.

3.2.3 Urban form

The Municipality forms a six finger-like shape with the centre (CBD) at the core. It has six growth directions following the main transport routes as shown in the map below. Developments along these roads take a linear pattern. Some of the spatial problems that have arose due to this current developing trend include:

- Decreasing agricultural land;
- Urban sprawl;
- Skewed development of the urban areas;
- Shrinking agricultural land;
- Emergence of new urban areas that lack basic services;
- Concentration of developments along major transport routes.

3.3 Environmental characteristics of the project area

3.3.1 Rainfall

The Municipality experiences comprising of the long rains and the short rains. The long rains occur between the months of April and May whereas the short rains are normally experienced during the months of December to February. The annual rainfall in the area ranges from 400mm (lowest) to 1,800mm (highest).

3.3.2 Temperature

The temperatures in Kimilili range between a maximum of 26^{o}C-28^{o}C and a minimum of 11^{o}C. The wind blows from East to West over the planning area.

3.3.3 Sunshine and Solar Radiation

Kimilili experiences and annual mean of approximately 12 hours of sunshine per day.

3.3.4 Humidity

The mean relative humidity is about 75%.

3.3.5 Wind Run

Kimilili town and its environs have an annual average wind run of about 6.1 km/hr. The wind run reduces as the altitude decreases. Also, the wind direction is East-southeast.

3.3.6 Topography and Terrain

The Municipality lies at an altitude of 1690m above sea level. The planning area is characterized by gentle undulating slopes. Higher and lower grounds are found at Kamtiong and Khamulati respectively. The slope analysis played a major role in determining the locations of various land use proposals.

The low lying areas of Kimilili river is characterized by fish ponds while relatively flat areas are characterized by buildings and agricultural activities due to terrain stability. Kamusinga area is characterized by residential developments due to the gentle sloping of the area.

Kamtiong Water Treatment Plan is located on the Northern part of the planning area at the slopes of Mt. Elgon. The plant is located on higher ground to facilitate the supply of water to the Municipality via gravity scheme.

3.3.7 Geology and Soils

The geology in the region comprises mainly pre-cambrian and cainozoic rock formations including volcanoes, granites; and sediments. The rocks on the slopes are deeply weathered; the dominant soils are vertisols, regionally known as “black cotton soils”. The top of the mountains is characterized by scarps of agglomerates in linear pattern The relief is relatively undulating and hilly with the highest catchment elevation at 3,616m above sea level and the lowest at 1,083m above sea level. The catchment is highly influenced by post volcanic activities and the soils are very variable. The impermeable nature of most of the rocks makes the adjacent areas of Mt. Elgon vulnerable to landslides during wet seasons. Top soils are shallow especially around the Mt. Elgon National Park. Generally, the soils in the highlands are clays, while those in the midlands and lowlands are clay loams or sandy.

3.3.8 Hydrology and Drainage

The rivers within the planning area originate from Mt. Elgon Forest. These rivers include Kimilili, Kibingei, and Sosio. Small streams such as Kamusinga and Lutonyi also traverse the area.

River Kibisi originates from Mt. Elgon which is situated at altitude of approximately 2,200 meters above sea level. It then flows downstream through a natural forest dominated mainly by indigenous trees/vegetation cover. The river leaves the forest edge and flows through a rich upland agricultural area of extensive and intensive human farming activities and settlements. In the lower reaches it passes through a floodplain before it eventually coalesces with River Sosio, and together they form a tributary that pours its waters into River Nzoia. The larger River Nzoia which has its origin in the Cherangani hills and Mt. Elgon water tower flows in the southern direction ending up in Lake Victoria.

The erratic weather changes due to climate change and the removal of the riparian vegetation from the river watershed have greatly affected the discharge of River Kibisi causing its volume to dwindle tremendously in recent years. The floodplain in the lowland is dominated by anthropogenic activities that include human settlements, farming, urbanization and grazing.

3.3.9 Land and Land Use

The main land use is crop farming and livestock production. Other land uses include forestry, mining, construction of human settlements, business, social and public amenities. The photographs below illustrate the intense farming practised in Kimilili.

3.4 Socio-economic characteristics of the project area

3.4.1 Economic development

Kimilili constituency economic position has recently appreciated especially in Kimilili town with presence of major financial institutions namely; Kenya Commercial Bank, Cooperative Bank, Ushirika Cooperative and Kenya Women Finance Trust among others. Kimilili town is a trading centre for agricultural goods and services. The main town centre has several economic activities which include retail grocery stores, supermarkets, schools and computer colleges. Kimilili constituency is a home to some of the largest open air markets in Bungoma County such as; New Kimilili-Makwata, Kamukuywa, Sosio, Matilili, Bahai, Bituyu, Sitabicha, Kibingei, Kibunde, Namawanga, Temba Temba, Chebukwabi, Chesamisi, Maeni, Mkulima, Kamasielo, Sikhendu and Wabukhonyi.

There are numerous non-governmental organizations in Kimilili, the two main ones being ICFEM and Omwabini. Kimilili has two coffee factories in Khamulati and Kibingei areas of Kimilili constituency. Kimilili maize mill located within Kimilili town is yet to be operational.

3.4.2 Transportation and Road Network

The Municipality has an extensive road network comprising of tarmac, murram and earth roads consisting of class C, D and E Roads. Major roads include Chwele-Kimilili-Kamukuywa Road, Kimilili-Kapsokwony-Road, Kimilili-Bokoli-Kanduyi Road and Kimilili-Misikhu Road. With the exception of the Kimilili-Kapsokwony Road, all these roads are tarmacked. Most of the internal access roads are untarmacked.

3.4.3 Demographic situation

Kimilli town had an urban population of 41,115 in 2009 census. Due to its strength in trade and education, Kimilili's urban population is on the rise. It was home to many government workers who held office positions in the former Mt Elgon District, which was merged into Bungoma County in 2010. The town is occupied mainly by two tribes namely the Bukusu and few Teso.

Table 3-2: Kimilili town population projections

Gender	2009 Census	2018 (Projections)	2020 (Projections)	2022 (Projections)
Male	19,800	26,061	27,701	29,445
Female	21,315	28,055	29,821	31,698
Total	**41,115**	**54,116**	**57,522**	**61,144**

Source: KNBS Population Analytical Report (2016)

Kimilili constituency has a total area of approximately 181.2 km^2 with a population density of 733 persons per km^2.

Area	2009 Census	2018 (Projections)	2020 (Projections)	2022 (Projections)
Land size (Km^2)	181.2	181.2	181.2	181.2
Population	132,822	174,823	185,830	197,530
Population density (Persons/ Km^2)	733	965	1,026	1,090

Source: KNBS Population Analytical Report (2016)

3.4.4 Administration

Kimilili is a town within Kimilili constituency in Bungoma County. The town was recently upgraded into a municipality whereby the affairs of Kimilili Municipality are now managed through the Municipality Manager. Kimilili constituency has four administrative wards namely Kibigei, Kimilili township, Maeni and Kamukuywa.

Table 3-3: Area of Kimilili Sub County by wards, location and villages

County Government Administrative Unit	Wards	Locations	Village Units	Area Km^2
Kimilili sub county	Kibingei	Kibigei, Chebukwabi	Daraja Mungu, Siuna, Kibunde, Kitoyi, Lutonyi, Khweroro	51.9
	Kimilili	Kimilili rural Kimilili township	Kimilili Township, Chelekei, Bahai, Matili, Lwanda, Sitabichi	42.1
	Maeni	Nasusi Sikhedu	Sikhendu, Nasusi, Kamasielo, Nameme	41
	Kamukuywa	Makhonge Nabitoto	Nabikoto, Musembe, Kimakwa, Mapera, Makhonge, Mbongi	46.1

Source: Bungoma County CIDP 2018-2022

3.4.5 Access to social infrastructure

3.4.5.1 Access to water supply

Primary source of water for Kimilili town is River Kibisi, also known as River Kimilili with an intake structure located at a river section within Mt. Elgon. Water flows by gravity to the conventional treatment works located 3km away from Kimilili town. The raw water from the River undergoes full treatment before flowing to the storage tanks in Kimilili Town and is thereafter distributed to serve the residents within and around the Town. The 2 No. existing conventional water treatment plants each have capacity of 2,500 m^3/day (Total 5,000m^3/day). In terms of storage, the system contains 2,500m^3 clear water tank to receive water after filtration and 2 No. 100m^3 and 300m^3 tanks placed at strategic places within the town. The existing system comprises of a 6km DN 150 gravity main and 15km DN 250 distribution network.

3.4.5.2 Sanitation facilities

There is no existing sewerage system serving the town at the moment. The population of Kimilili relies on VIP latrines, septic tanks and pit latrines for disposal of wastes. These type of facilities are also very few due to existing high water tables within and around Kimilili Town. When these facilities are filled up they exhaust and discharge using private

lorries to designated treatment works in Bungoma or Webuye. However, some people resort to exhausting of the effluent manually at night and disposing the same into open drains which drains the effluent to Kimilili River. The problem is compounded by lack of exhauster services which is only available in Kakamega town, 60km away from Kimilili. Some people throw human waste into refuse pits using polythene bags at night, a practice known as flying toilets. The waste water from washing areas also stagnates along the road due to lack of proper drainage system and as a result springs and wells are polluted by underground seepage from toilets. This situation has inadvertently led to the upsurge of water borne diseases such as cholera which are directly or indirectly linked to poor wastewater management.

3.4.5.3 Access to education

Kimilili constituency has several education institutions including primary, secondary schools, training institutes and a teachers training centre. It boasts of major top performing academic institutions such as Friends School Kamusinga. Other high schools are Moi Girls Kamusinga, Kimilili Boys, Chesamisi High School, St Teresa 's Girls Secondary School, Maeni Girls Secondary School, and St. Mary's Sosio Secondary School, among others. Primary private schools include PHIM primary school, Shekinah school, Dreamland Education Centre and Farcon Academy. Public primary schools are Kimilili R.C. boys', Kimilili R.C. Girls', Kimilili D.E.B, Kamusinga Primary, Khwiroro Primary, Bituyu, Buko and Maeni primary schools. Additionally, Matili F.Y.M Primary, Matili R.C, and Namawanga primary schools are a few schools which have produced scholars.

Matili Technical Training Institute which is in the heart of Kimilili Constituency provides the much needed skill gap in the field of plumbing, tailoring, electrician, plant machinery operators among other skills. It also has a teachers' training centre (Shima TTC). Kimilili is also a home to the Western Provincial Police Training Centre.

Kimilili constituency hosts Amutala Stadium that has the potential for improvement and expansion into a modern facility. This facility has given rise to many prominent sports personalities in Kenya.

3.4.5.4 Access to health services

According to District Health Information Systems (DHIS) of 2016, Kimilili sub-county has a total of 13 health facilities. One sub-county (level 4), one health centre (level 3a), eight dispensaries (level 2), two private clinics, and one faith based health centre. The sub county has bed occupancy of 76%, with a total of 202 beds. Some of the health facilities in Kimilili town include Kimilili sub-county Hospital, Dreamland Mission Hospital, Kori Family Hospital, Bliss Medical Centre, Chrizah Medical Clinic and Khamulati Medical Clinic.

The top ten diseases in Kimilili include; malaria, upper respiratory tract infection, skin diseases, pneumonia, urinary tract infection, eye infections and cholera. Some of these diseases are water borne and water related in nature and is directly or indirectly linked to poor waste water management.

3.4.5.5 Transport and communication

Kimilili has fair road network connecting to neighbouring constituencies. The main streets within Kimilili Town are paved. On the outskirts, the roads are mainly earth/gravel roads. The road network includes; Kimilili – Kamukuywa - Kitale – Lwodar road, Kimilili- Chwele – Sirisia – Korosiandet – Lwakhakha road, Kimilili – Bokoli – Sikata – Bungoma road, Kimilili – Matili – Misikhu – Webuye, Kimilili – Kamasielo – Kapsokwony Road, Kimilili – Kapkateny road. This has gone a long way in easing trade and opening up remote areas of Kimilili Constituency.

Kimilili town is well covered with several mobile phone service providers, key ones being Safaricom, Airtel, and Telkom.

3.4.5.6 Sources of energy

Most households and institutions in Kimilili town use electricity for lighting as some of them have been connected to electricity under the last mile connectivity program. Others use solar and kerosene lamps as their main source of lighting. The most common sources of energy for cooking in Kimilili town are firewood, with others using gas cookers and charcoal as cooking fuel.

3.4.5.7 Cultural and historical sites

Many historians and students of history travel to Kimilili Constituency for fact learning at Mausoleum of the late Dini ya Musambwa's leader and freedom fighter Elijah Masinde Wanameme's and also to ancestral homes of Kenya's National heroes and great leaders such as the late Masinde Muliro , the late Vice President Michael Wamalwa Kijana and Pascal Nabwana, among others.

3.4.5.8 Agriculture

Kimilili constituency has subsistence and commercial agriculture as the main economic activity. The constituency prides itself with fertile land and favourable climatic conditions; being a source to rivers and springs such as Kibisi, Sosio, Matili, Chelekeyi, Nandika and Kibingei. Kimilili town is surrounded by mainly farmland, the main crops grown in Kimilili Constituency are; Maize, Beans, Cassava, Finger millet, Ground nuts, Sweet potatoes, Bananas, Tomatoes, coffee and Sorghum. Maize meal forms the staple food for the Constituency. Maize is generally grown in large scale while beans, millets and sorghum are grown in small scale. Coffee and sugarcane are the main cash crops grown in the area. This is evident with the presence of the two coffee factories in Khamulati and Kibingei areas of Kimilili constituency. Also the availability of dams at Chebukwabi, Bituyu and Matili FYM which aid in boosting agricultural activities.

4 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

4.1 Policy provision

4.1.1 Kenya Vision 2030

Kenya's Vision 2030 aspires to transform Kenya into a newly industrialized middle-income country by 2030. The blueprint recognizes that Kenya is a water scarce country and further that the economic and social development envisaged in the vision 2030 will require more high quality water supplies. The water and sanitation sector goal in line with the Vision 2030 is "to ensure that improved water and sanitation are available and accessible to all". One of the strategies proposed is to construct water and sanitation facilities to support industries and the growing urban population. Regarding environment, the Vision states that Kenya aims to be a nation living in a clean, secure and sustainable environment by 2030.

Relevance

The proposed project aims at improving sanitation in Kimilili Town.

4.1.2 National Environment Policy (NEP)

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 semiarid 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

An Environmental Impact Assessment has been completed for the proposed project prior to implementation and the relevant licenses applied for, the proposed Project shall also implement the Environmental Management Plan (EMP) to mitigate the impacts during the construction and operational phases of the project, this will ensure that the sensitive ecosystems are protected.

4.1.3 National Land Policy

The National Land Policy in Chapter 3 under section 3.4, Environmental Management Principles, provides for the policy actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution of air, water and land. The policy advocates 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 meetings have been held for the proposed project as required in the preliminary stages of Environmental and Social Impact Assessment.

4.1.4 National Water Policy

The National Water Policy was promulgated in April 1999 as Sessional Paper No. 1 of 1999 and calls for decentralization of operational activities from the central government to other sectors, including local authorities, the private sector and increased involvement of communities in order to improve efficiency in service delivery.

The overall objective of the National Water Policy is to lay the foundation for the rational and efficient framework for meeting the water needs for national economic development, poverty alleviation, environmental protection and social well-being of the people through sustainable water resource management.

4.1.5 HIV and AIDS Policy 2009

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 programs 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.

4.1.6 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.

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.

4.1.7 National Occupational Safety and Health Policy 2012

The Policy addresses the current challenges, gaps and future development of safety and health systems and programs in Kenya. It is expected to promote basic principles of assessing occupational risks and/or hazards; combating hazards at source; and developing a national preventative safety and health culture that includes information, consultation, research and training.

The Policy applies to all workplaces in all sectors of the economy and all forms of work guided by the existing laws on Occupational Safety and Health (OSH), Work Injury Benefits and other relevant regional and International Labour Standards without any exemption. The main focus is prevention and control of work-related accidents and diseases, compensation and rehabilitation of workers injured in the course of work and those who contract occupational diseases.

4.2 Relevant Legislations

4.2.1 Constitution of Kenya

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

(a) To have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and

(b) To have obligations relating to the environment fulfilled under Article 70 The constitution also emphasizes on that:

(i) Land use and management shall by law benefit local communities;

(ii) Community land is protected from encroachment by State;

(iii) Law shall protect Rivers, forests and water bodies;

(iv) Equitable access to land;

(v) County governments will manage land in trust of the people in accordance with the proposed Constitution.

4.2.2 The Environment Management and Coordination Act (EMCA) Cap 387

An Act of Parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. PART II – GENERAL PRINCIPLES 3. Entitlement to a clean and healthy environment (1) Every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment. To achieve this goal, the projects listed under the Schedule No. 2 of EMCA must be subjected to Environmental Impact Assessment (EIA). The proposed project falls within the Second schedule and must therefore comply with EMCA requirements in as far as EIA is required. The regulations under EMCA that will influence the operation of the project are:

- The Environmental (Impact Assessment and Audit) Regulations, 2003 Legal Notice No. 101;
- The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121;
- The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120;
- The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61;
- The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160;
- Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009;
- The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73.

4.2.3 Water Act 2016

The passage of Kenya's 2010 Constitution has had a wide set of implications for the water sector. Primarily, the Constitution acknowledges access to clean and safe water as a basic human right and assigns the responsibility for water supply and sanitation service provision to 47 newly established counties. The purpose of the 2016 Water Act is to align the water sector with the Constitution's primary objective of devolution. The act recognizes that water related functions are a shared responsibility between the national government and the county government. It also gives priority to use of abstracted water for domestic purposes over irrigation and other uses.

The act sets in place the Water Resources Authority (WRA) whose objective of is to protect, conserve, control and regulate use of water resources through the establishment of a national water resource strategy. In addition, the WRA is responsible for:

- formulation and enforcement of standards, procedures and regulation for the management and use of water resources;
- policy development;
- planning and issuing of water abstraction permits; and
- setting and collecting permits and water use fees.

Water Rules 2007

The Water Resources Management Rules, 2007 was gazetted to guide all policies, plans, Programs and activities that are subject to the Water Act, 2002. The Water Resources Management Rules empower Water Resources Authority (WRA) to impose management controls on land use falling under riparian land. It also enables any person with a complaint related to any matter covered by these rules to the appropriate office in WRA as per the Tenth Schedule which provides a format for report on complaints. Part A of the Sixth Schedule: Conservation of Riparian and Catchment Areas of the Rules (rule 116) define the riparian land on each side of a watercourse as a minimum of six meters or equal to the full width of the watercourse up to a maximum of thirty meters on either side of the bank. It further provides activities proscribed on riparian land as:

- Tillage or cultivation;
- Clearing of indigenous trees or vegetation;
- Building of permanent structures;
- Disposal of any form of waste within the riparian land;
- Excavation of soil or development of quarries;
- Planting of exotic species that may have adverse effect to the water resource; or
- Any other activity that in the opinion of the Authority and other relevant stakeholders may degrade the watercourse.

4.2.4 County Government Act No. 17 of 2012

An Act of Parliament to give effect to Chapter Eleven of the Constitution; to provide for county governments' powers, functions and responsibilities to deliver services and for connected purposes. In the Fourth Schedule of the Kenyan Constitution 2010 Part 2 County governments, one of the functions of the County governments is stated as "11. County public works and services, including— (a) storm water management systems in built-up areas; and (b) water and sanitation services. "

4.2.5 Occupational Health and Safety Act (OSHA 2007)

Occupational Safety and Health Act (OSHA) is an Act of Parliament that provides for the safety, health and welfare of all workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. It applies to all workplaces where any person is at work, whether temporarily or permanently. The purpose of this Act is to:

- Secure the safety, health and welfare of persons at work; and
- Protect persons other than persons at work against safety and health arising out of, or in connection with the activities of persons at work.

4.2.6 Work Injury Benefits Act (WIBA), 2007

It is an act of Parliament (No. 13 of 2007) to provide for compensation to workers for injuries suffered in the course of their employment It outlines the following:

- Employer's liability for compensation for death or incapacity resulting from accident;
- Compensation in fatal cases;
- Compensation in case of permanent partial incapacity;
- Compensation in case of temporary incapacity;
- Persons entitled to compensation and methods of calculating the earnings;
- No compensation shall be payable under this Act in respect of any incapacity or death resulting from a deliberate self-injury; and
- Notice of an accident, causing injury to a workman, of such a nature as would entitle one for compensation shall be given in the prescribed form to the director.

4.2.7 The Public Health Act (Cap.242)

This is an Act of Parliament to make provision for securing and maintaining health. Section 115 of this act prohibits causing nuisance or other conditions liable to be injurious or dangerous to health. Section 118 provides a list of nuisances that includes any noxious matter, or wastewater, flowing or discharged from any premises, wherever situated, into any public street, or into the gutter or side channel of any watercourse, irrigation channel or bed thereof not approved for the reception of such discharge.

4.2.8 Eviction Way leave and Rehabilitation Bill (2014)

- Every person shall be protected from arbitrary eviction;
- The persons, affected by an eviction should not suffer detriment to their human rights;
- The state 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.

4.3 Institutional Framework

4.3.1 Ministry of Water and Sanitation & Irrigation

The mandate of the Ministry is to protect, conserve and manage water resources and ensure sustainable use of water for agriculture in Kenya with a view of supporting socio-economic development, reduce poverty, improve living standards and ensure a clean environment. The Ministry's Water Department has its fundamental goal and purpose as conserving, managing and protecting water resources for socio-economic development. Its aim is to improve the living standards of people by ensuring proper access to available water resources.

4.3.2 Water Services Regulatory Board (WASREB)

- 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 Agencies and approving their appointed Water Services Providers;
- Monitoring the performance of the Water Services Agencies 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.

4.3.3 Water Resources Authority (WRA)

The authority is responsible for sustainable management of the Nation's Water Resources:

- Implementation of policies and strategies relating to management of water resources;
- 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.

4.3.4 NEMA

The National Environmental Management Authority (NEMA) is the supreme regulatory and advisory body on environmental management in Kenya under EMCA Cap 387. NEMA is charged with the responsibility of coordinating and supervising the various environmental management activities being undertaken by other lead agencies. NEMA also ensures that environmental management is integrated into development policies, programs, plans and projects. The proposed project Environmental and Social Impact Assessment report will be submitted to NEMA for Licensing prior to project implementation, also Environmental Audit and monitoring reports will be submitted as required.

4.3.5 Water Works Development Agencies (WWDAs)

- 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 proposed project areas are under Central Rift Valley Water Works Development Agency (CRVWWDA) and Lake Victoria North Water Works Development Agency (LVNWWDA).

4.3.6 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. The relevant water services provider for the project area is NZOWASCO.

4.4 African Development Bank Policies on Environment Protection

4.4.1 OS 1: Environmental and Social Assessment

This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements.

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

This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and incorporates a number of refinements designed to improve the operational effectiveness of those requirements.

4.4.3 OS 3: Biodiversity and Ecosystem Services

This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management into operational requirements.

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

This safeguard covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.

4.4.5 OS 5: Labour Conditions, Health and Safety

This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development banks.

Table 4-1: Project Activities Triggering AfDB Operational Safeguards

Policy	Criteria in the Project	Discussions
OS 1: Environmental and Social Assessment	Yes	The Project components will trigger Environmental Assessment (EA) safeguards and is Category B due to the interaction with the physical, biological and social setting within the immediate surroundings.

Policy	Criteria in the Project	Discussions
OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation	Yes	The Project will utilize existing public land, road reserves and river riparian, however, in some cases there will be encroachment to private land hence a RAP has to be completed as part of the project.
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.
OS 5: Labour Conditions, Health and Safety	Yes	The Project shall involve workers both during construction and operation phases of the project.

4.5 International Conventions

Relevant international agreements, treaties and conventions that have a social and/or environmental aspect to which Kenya is a signatory or ratified to are detailed in the table below:

Table 4-2: International Conventions relevant to social and/or environmental aspects

Conventions	Date Ratified/ Acceded to
African Convention for the Conservation of Nature and Natural Resources (2003)	Ratified (12 May 1969)
Convention on Biological Diversity (1992)	Ratified (26 July 1994)
Vienna Convention for the Protection of the Ozone Layer (1985)	Acceded to (9 November 1988)
UNESCO Convention for the Protection of the World Cultural and Natural Heritage (1972)	Acceded to (1 May 1964)
Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1995)	Acceded to (1 June 2000)
Convention on Biological Diversity (2006)	Ratified (26 July 1994)
Convention on Climatic Change and the Kyoto Protocol (1997)	Ratified (25 February 2005)

5 PROJECT ALTERNATIVES

The objective of alternative analysis is to define the merits and demerits of realistic alternatives, thereby providing decision makers and the public with a clear basis for choosing between options. We have systematically compared feasible alternatives for the proposed project, technology, design, and operation-including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. Assessment have occurred in parallel with development of the designs, to allow maximum exchange between the Environmental expert and the design engineers.

For each of the alternatives, the analysis has quantified the environmental costs and benefits to the extent possible, and attached economic values where feasible. This includes analysis of:

- Costs and benefits of environmental impacts;
- Costs, benefits, and cost-effectiveness of mitigation measures; and
- Discussion of impacts that have not been expressed in monetary values, in quantitative terms where possible;
- Operation and maintenance requirements among others.

5.1 “Without the project” scenario

In the analysis of “without the project” scenario, the following criteria is used; past, current and future effect/ impacts of the sewerage as currently existing, anticipated benefits of proposed project plus any other considerations are analysed.

The selection of “without the project” alternative would mean the discontinuation of proposed project and result in the project being retained in its existing form. As such, this alternative is likely to have the greatest implications on the socioeconomic environment of the area and surrounding communities. Due to the proposed size of the development, it is anticipated that it will have the following benefits:

- 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;
- Improved Sanitation of Town;
- Improve Health and Hygiene of residents;
- Reduced cases of Water borne related diseases;
- Creation of job opportunities during operation phase.

We have examined following alternatives to the extent possible with the available data, and compared with the proposed project in terms of potential environmental impacts, possible mitigation measures, cost, suitability etc.

5.2 Analysis of alternative construction materials and technology

The proposed project will be constructed using the following materials mainly;

- Double Wall Corrugated (DWC) HDPE and Precast Concrete (PCC) pipes;
- Survey equipment;
- Excavation equipment;
- Vehicles including dumper tippers;
- Micro tunnelling equipment;
- Epoxy coated steel pipes and sleeves.

This ESIA proposes that rainwater should be harvested and used in construction activities whenever there is water usage need. Heavy use of timber and wood during construction should be discouraged to minimize destruction of trees. The exotic tree species should be preferred to indigenous species in the construction of the project components where need will arise as they can be replanted with ease.

The equipment and vehicles should have highest levels of combustion efficiency, capability to use cleaner fuels like biofuels and should have enhanced safety features.

6 PUBLIC PARTICIPATION

This Chapter describes the process of public consultation and participation that were followed to identify the key issues and impacts of the proposed project. Stakeholder Engagement and Public Participation Process is an integral aspect of successful decision making in the ESIA processes for major developments. Public participation is a key requirement as stipulated in Article 69 Section 1 of the Kenyan Constitution, 2010, Legal Notice 101 of the Environmental Management and Coordination Act (EMCA), 2015, Section 3 of the EIA/EA regulations, 2003 and Section 87 & 113 of the County Governments Act, 2012.

The meetings carried out, attendance of the meetings/ minutes from diverse sectors of the society is attached in this report in Appendix D.

6.1 Objectives for consultation and public participation

The general objectives of the consultation and public participation were to:

- Disclose and inform the stakeholders about the project with special reference to its key components and location;
- Create awareness among the public on the need for the ESIA for the proposed project;
- Gather comments, suggestions and concerns of the interested and affected parties;
- Incorporate the information collected in the ESIA study.

6.2 Methods used for consultation and public participation

The public consultation and participation was conducted through:

- Household socio-economic survey;
- Key stakeholder interviews;
- Public Meetings.

The procedures used for each of the above are outlined below.

6.2.1 Household Socio-Economic Survey

Random Household Socio-economic surveys were conducted during the field visit. This was done using structured questionnaires (Questionnaire attached in the Appendices) to assess the socioeconomic status of the project area.

6.2.2 Key stakeholder interviews

Key Stakeholder meeting was held on 11 June 2019 at NZOWASCO office Webuye town, Bungoma County, during the reconnaissance visit. Courtesy calls were also made to the county commissioners' offices in Bungoma town to follow protocol on publizing the public barazas via Deputy County Commissioners, foster better mutual understanding of public concerns as well as incorporate key stakeholders' opinions regarding the proposed project.

6.2.3 Public meetings

Three (3) public participation meetings were conducted at the proposed sites as shown in ***Table 6-1*** below. The local Chief, Sub-chiefs, was used to mobilize the public to attend the meetings. The announcements for the meetings were made by phone calls, announcement at centres and settlements, in places of worship and chiefs barazas. A total of 193 people participated in the meetings.

Table 6-1: Public meetings held at Kimilili Town

Days	Area	Date	Time	Number of Attendees
1	Sindani village	29th July 2019	10.00am-1.00pm	95
2	Khamulati village	29th July 2019	2.00pm-5.00pm	43
3	Buyanji village	30th July 2019	10.00am-1.00pm	55

6.3 Comments obtained during the public consultation meetings:

This section provides a summary of the positive impacts of the proposed project as expressed by the stakeholders and public who were interviewed during the meetings.

Table 6-2: Issues raised and responses made during the Public Consultation Meeting, held between 29th and 30th July 2019, Kimilili town

No.	Concern/Comment/Question	Response/Recommendation
Sindani Village		
3.	Mustapha Tsalwa sought to know if the sewage line will encroach on private land or homesteads	Surveyors will determine the exact areas for the sewer line depending on the gradient of the area, there might be encroachment to private property and if so there will be compensation.
4.	Emily was concerned that the sewer system will contaminate the nearby rivers and also production of pungent smell	Mr. Mwangala of NZOWASCO assured the community that proper treatment of the sludge will be done at the treatment plant to eliminate harmful bacteria and germs before release to the river. The sludge will undergo total treatment. There are also special trees to be planted around the treatment plant to absorb the foul smell from the treatment works.
5.	Lynet Naliaka sought to know what will happen to those who will not be able to connect to sewer due to high connection fee	After the installation of the main trunk line, you can talk to your local legislatures MCA to help with connection because feeder roads, water and sanitation have been devolved to counties.
6.	James Wafula sought to know if NZOWASCO will hire a watchman to man the sewer manholes from vandalism	No watchman for the manholes. We shall use concrete made manhole covers instead of steel to minimise vandalism.
7.	The residents wanted to know if there will be compensation for negative impacts of the of the project for example invasion to crops by animals from the ponds	The treatment plant will be guarded 24 hours; it will also have a perimeter wall so the probability of animals invading the farms will be minimal.
8.	David Odhiambo-will you be connecting households to sewer?	No. only installation of the main trunk line. Feeder roads connection is for the county government, then from the feeder roads to households is the household owner's responsibility.
9.	Musa Masinde- will there be compensation for those affected by the sewer line	The surveyors will determine the wayleave for the sewer line and the project will make use of public land (roads) and riparian lands but if there will be any encroachment to private land, there will be compensation
Khamulati Village		
10.	Erustus James raised a concern on the proposed site for the treatment plant, claims that it is close to town and request if there is an alternative because he does not support the proposed site. Also needed assurance that the sewage will be properly treated before release to the rivers. Also needed clarification on where the sewer pipe will be passing	The purpose for this public meeting is to incorporate the local community opinion and concerns in the feasibility study report and currently there is no alternative site, but if the locals do not support the proposed site the project might not take off. Proper treatment will be done before releasing to the river. Sewer line wayleave will be determined once the surveyors come to the ground and will mainly use the public land(roads) and riparian land
11.	One participant sought to know if there will be insurance for construction casuals in case of any accident at work.	Workers will be issued with PPEs and insurance cover by the contractor.
Buyanji Village		
12.	Samuel Sitati- what will happen to those who will need sewer connection but are not connected to NZOWASCO	

No.	Concern/Comment/Question	Response/Recommendation
	piped water since most households here use spring water, boreholes, only a few are connected to piped water and do not need piped water.	
13.	Abraham Ali sought to know how long it will take for compensation to be done for those affected	The project is still in the initial stage- feasibility study. A rap will be done and those affected to be compensated in order to acquire the land for treatment plant.
14.	One participant requested that the notice for the next meeting be given in good time so that all affected parties get to participate.	Notice for the RAP meeting will be goven in good time
15.	Amos Amsada raised a concern that majority of the residents in the proposed treatment plant site do not have tittle deeds, therefore if land ownership documents will be needed for compensation purposes, it may be difficult for them and suggests if agreements can be used for compensation. Majority have agreement documents no title deeds	
16.	Moses Busulu- how will communal lands be compensated?	You will agree amongst yourselves and give out a name of the person to be used for compensation process- a representative
17.	Abraham Lukeko- how will the valuation rates be determined?	Rates will be agreed on by the valuers from both county level and national government and SMEC depending on current land rates of the area.
18.	One participant sought to know if there will be compensation for graves	We shall try as much as possible to avoid cultural sites like shrines, graves etc but where not possible there will be compensation for the same
19.	Samuel Sitati requested for a case study- that the client to take a representative group from the community to a town with an operating treatment plant for a visit as this will enable the residents interact with them and understand better and clear doubts about sewerage	A case study is a good idea but it needs to be planned for the logistics because the nearest town with a proper working waste water treatment plant is Eldoret or Kisumu towns.
20.	Musa Masinde requested that compensation be done before construction activities commence because there are cases of non-compensation during roads construction in the area. Request that compensation be done in a transparent and honest way. Requested the chief to confirm the rightful details of the affected persons He was also concerned that majority of the residents have not attended the public consultation meeting	
21.	One participant sought to know the project construction commencement date and if the locals have enough time to obtain the tittle deeds before the construction begins	Mr. Musili gave the project timeline
22.	The community requested for CSR- To classrooms at DEB Hamlati and a dispensary at Buyanji Village	

7 ENVIRONMENTAL IMPACTS ASSESSMENT & MITIGATION

The proposed Kimilili Sewerage project will have both positive and negative environmental impacts. Through an intensive and extensive field visits/ survey, key stakeholder consultation social survey and public participation forums conducted on the proposed project area, the impacts were identified and categorised according to different phases of the project i.e. construction, operation and decommissioning phases.

The magnitude and significance of impacts were based on the following factors:

- Location or extent: The area/volume covered;
- Timing: Whether immediate or delayed;
- Duration: Short term, long term, intermittent or continuous;
- Reversibility or irreversibility;
- Likelihood: Probability of the impact taking place;
- Significance: Whether it is local, regional or global.

To make the following observation, expert knowledge based on the magnitude of the predicted impacts was relied upon.

The scale that was applied in the analysis of impacts is shown in the table below.

Table 7-1: Levels of Scale used in the Analysis of Impacts

Value	Description	Scale Description
0	No impact	This means that to the best knowledge of the expert, the activity/action will not have any known impact on the environment. Such an impact will not in any way affect the normal functioning of either the human or the natural systems and does not therefore warrant any mitigation.
1	Minimal impact	Any activity with little impact on the environment calls for preventive measures, which are usually inexpensive and manageable. Such activities have minimum impacts on either natural or human environment or both.
2	Moderate impact	A moderate impact will have localized effect on the environment. If the effect is negative and cumulative, action in form of mitigation measures needs to be put in place to ensure that it doesn't become permanent and /or irreversible.
3	High impact	An impact is high if it affects a relatively high area (spatial), several biological resources (severity) and/or the effect is felt for a relatively long period (temporal) e.g. more than one year. In case the effect is negative, such an impact needs to be given timely consideration and proper mitigation measures put in place to prevent further direct, indirect or cumulative adverse effects.
4	Very high impacts	Such an activity rates highly in all aspects used in the scale i.e., temporal, spatial and severity. If negative, it is expected to affect a huge population of plants and animals, biodiversity in general and a large area of the geophysical environment, usually having trans-boundary consequences. Urgent and specialized mitigation measures are needed. It is the experts' opinion that any project with very high negative impacts MUST be suspended until sufficient effective mitigation measures are put in place.
5	Not known	There are activities for which impacts are not yet known e.g. some chemicals are suspected to produce carcinogenic effects, but this has not yet been confirmed.

Once potential impacts of the proposed project had been identified, the ESIA team went further to predict the nature of the impacts. Predictions were normally based on explicit assumptions about environmental processes, professional judgment and different value judgments expressed by various stakeholders during consultations. Determination of the significance of the potential impacts was based on the three broad categories of determining impact significance. These are discussed in the following section as construction, operation and decommissioning phase.

7.1 Positive environmental and social impacts during construction phase

The following are the expected positive environmental and social impacts for the proposed Kimilili town sewerage project during the construction phase:

7.1.1 Creation of employment opportunities

The construction phase of the sewer project will offer job opportunities for both skilled and unskilled locals in the area. The locals will be employed as casuals, and other permanent consultancy and technical staff during the construction of the road. Civil and structural engineers, masons, carpenters, welders and other casuals will all gain employment during the construction phase of this road. These jobs are expected to improve the economy of the area and improve the livelihoods of the local people.

7.1.2 Gains in the local and national economy

Through the provision of employment to the locals, income from the salaries and wages will improve the economy of the town centres and the county at large. The contractor is also expected to purchase most of his materials from the project area and as such contribute positively to the local and national economy. The materials for construction will also be sourced from other areas within the nation hence positively affecting the national economy.

7.1.3 Transfer of skills

During construction of the proposed project, many people from within and without the area will be employed to provide different services during construction and probably maintenance. Local people will learn new skills from the civil engineers, welders, masons and other employees that come from outside.

7.1.4 Provision of market and supply for building materials

The contractors will purchase building materials such as wood, metals, sand, gravel cement etc. from suppliers within or outside the area.

7.1.5 Injection of money into the local economy

The contractors will pay suppliers and pay workers within the area

7.1.6 Creation of wealth to residents through direct and indirect business

In the construction phase, building materials will be purchased both locally and regionally. Other small-scale business people such as food vendors, kiosk owners, hotels and lodgings will also benefit during the construction.

7.1.7 Interaction of people from different communities

The members of the public revealed that this project will promote national cohesion since people from different communities in Kenya will be working together during construction phases of the project.

7.2 Negative environmental and social impacts during construction phase

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 likely negative environmental and social impacts during the construction phase of the project are:

7.2.1 Disruption and loss of businesses

Project impact to private property and sources of livelihood along the roads and river riparian. During the field survey, we noted that some small-scale businesses and temporary structures may be affected. They might be displaced to pave way for construction of the proposed project. However due to the anticipated resettlement action plan (RAP), this impact will be low hence a value of 1.

7.2.2 Vegetation clearing, soil erosion and siltation

During the construction phase of the project, there will be clearance of vegetation along the corridor to pave way for the proposed sewerage. The project area has scarce vegetation and therefore there will be minimal clearance of vegetation. It is expected that the project will require huge quantities of materials such as ballast, murram, stones, conglomerates, sand, gravel, and soil, among others. In addition, the contractors will install several material camp sites as well as a batching plant that will impact on the environment, especially with smothering vegetation species around the camp sites.

The proponent is going to ensure that campsites and quarries are constructed in areas that are not high in vegetation density. Due to the need to clear vegetation existing for quarries and building of campsites. All borrow pits and quarries

will need to undergo a separate Environmental and Impact Assessment Study so as to ensure there will be no major negative impacts from them. This impact will be moderate hence value of 2.

7.2.3 Air quality pollution

Air quality pollution caused by emissions from construction plant and equipment which include dust and gaseous emissions. In the construction phase, the excavations, demolitions, and transportation of building materials will result in the emissions of large amounts of dust within the project site and surrounding areas. Asphalt, concrete and batching plants are also possible sources of dust and air pollution within the project area. The contractor is expected to conduct separate EIAs for the batching plants and monitor the dust levels periodically as stipulated in the Environmental Monitoring Plan, also will minimise this through sprinkling water on daily basis on the areas that transport trucks use and excavated areas. This impact will be moderate hence value of 2.

7.2.4 Noise and excessive vibration

Noise and excessive vibration from construction equipment and vehicles. Because of excavation, crushing, construction and demolition works, there will be high noise and vibration levels in the project area. Noise and vibrations will emanate from transportation vehicles, construction machinery, metal grinding and cutting equipment, and among others. Excavation works will also cause vibration and noise. Quarry pits that will be used for sourcing of construction material will also result to noise emissions. However, the proponent is expected to take appropriate steps to minimize noise pollution through provision of appropriate personal protective equipment to construction workers, minimizing the frequency of transport of construction materials and ensuring that all construction machinery is well maintained, all quarries will be subjected to independent Environmental Impact Assessment (EIA) studies. This impact will be moderate hence value of 2.

7.2.5 Water quality pollution

Water quality pollution from construction activities which include solid and effluents waste. It is expected increase in the generation of wastewater and sewage during the construction phase of the project. The increases will take place at construction camp sites and at project sites. There will be impact due to oil spillage, disposal practices of used oil, oil filters during the construction of the project. This impact will be moderate hence a value of 2.

7.2.6 Hydrology within Project site

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. Utilize excavated soil to level excavated ground where necessary and cover the water and sewer lines that will have been laid in the ground. This impact will be moderate hence a value of 2.

7.2.7 Interruption of existing infrastructure

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 work plan with clear responsibilities for each party should be developed to ensure smooth execution of the construction. This impact will be moderate hence a value of 3.

7.2.8 Solid waste generation

Solid waste generation from construction activities will be expected. Volumes of solid wastes will be produced during the different phases of the project development. Solid waste materials will be generated during excavation works as well as from various packaging materials. Significant quantities of rock and soil materials will be generated from earth moving during construction activities. The contractor would need to ensure that all solid wastes are collected and disposed appropriately to promote a clean and healthy environment. The contractor shall comply with recommendations of solid waste management provided in the ESMP. This impact will be moderate hence a value of 2.

7.2.9 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. This impact will be moderate hence a value of 2.

7.2.10 Occupational health and safety risks

Occupational health and safety risks associated with the Project. The Occupational safety and health issues associated with the construction will include; physical hazards, chemical hazards and noise hazards. Chemical hazards in construction will principally be associated with exposures to, dust during construction; exhaust emissions from heavy equipment and motor vehicles during all construction activities.

However, other physical hazards include exposure to weather elements (heat), noise, work in confined spaces, trenching, overhead power lines contact, falls from machinery or structures, and risk of falling objects. There is also a possibility of accidents when transporting workers to the construction sites. This impact will however be low hence a value of 2.

7.2.11 Spread of communicable diseases and HIV/AIDS infection;

Consultants and residents expressed concern that there would be an increase in incidences of sexually transmitted diseases including HIV and AIDS especially during construction of the project because of increased prostitution. The project proponent will need to work jointly with appropriate county and national government health agencies to come with a comprehensive STD, HIV and AIDs control programme during the construction and operational phases of the project. This impact will be moderate hence a value of 2.

7.2.12 Gender Based Violence

Due to inequalities between genders as a result of employment from the construction works, it is anticipated that cases of gender based violence might occur. This will be compounded by issues such as compensation for land acquisition, regular source of income, growth of businesses and among others. Though men are victims of gender based violence, women are more prone and vulnerable to experience it. This impact will be moderate hence a value of 2.

7.2.13 Cultural changes

The project is likely to increase the attractiveness, which may result in the following:

- Increase in undesirable sexual and social interaction in the area;
- Degradation of the cultural values and norms in the area;
- Increase in the levels of crime in the area.

7.2.14 Gender and equality biases

Always Gender and equality biases in construction projects may be to the basis of differential treatment of persons based on their sex roles, ethnicity, status, religion, race, age, beliefs and disability among other attributes. The Contractor and proponent should put measures in place to address issues of gender equality and freedom from discrimination among all Kenyans that will be involved in the project with a focus on Special Interest Groups, namely; women youth, children, persons with disabilities (PWDs), the elderly and minority and marginalized groups and communities. The proponent is expected to roll out programs and activities in various sectors including health, education, housing, employment and social support and justice among others. The overall goal will be the reduction of gender inequalities and the discrimination against all interest groups during the project cycle. Therefore, this impact will be low hence a value of 1.

7.2.15 Sexual Exploitation/Child Abuse

As a result of land and property compensation plus influx of workers into the area due to the project construction, it is anticipated that there will be a lot of money in circulation and this may lead to the sexual abuse of young children by the workers for exchange of money, food or other basics of life. Other forms of child abuse might be the employment of minors for labour at the construction site. This impact will be low hence value 1.

7.3 Positive environmental and social impacts during operation phase

The following were the positive environmental and social impacts for the proposed project during the operation phase:

- Creation of employment opportunities: Both direct and indirect employment opportunities will emerge during the operation phase. For the direct employment, people will be employed for the normal and continuous maintenance.
- Improved Sanitation;
- Currently the locals are using pit latrines and septic tanks. Therefore, the project will automatically lead to improved infrastructure;

- Improved Health and Hygiene of residents;
- Reduced cases of water borne related diseases;
- Growth of secondary businesses in the project area;
- Achieve economic benefit by saving some healthcare expenses, improving people's productivity and improving water resources management;
- Increased revenues for the service providers;
- Improvement in groundwater quality through preventing infiltration of sewerage from porous cesspits and pit latrines;
- Improve living conditions for targeted residents through achieving the above environmental benefits, upgrade their real estate values and contribute in alleviating poverty conditions through work opportunities in construction and operation of the project;
- Strengthen community participation in environmental protection through involving community based organizations in project operation and mobilization activities;
- Land Value will go up;
- Corporate social responsibility (CSR): The contractor will identify the needful areas in the project area and participate in CSR activities. Some of the noted problems in the area are: unavailability of water, poor education and health infrastructure, employment, among others. Therefore, the contractor is expected to assist in any of these areas as part of CSR. Further, material sites such as borrow pits may serve as water collection points.

7.4 Negative environmental and social impacts during operation phase

7.4.1 Risk of encroachment and construction of structures on the sewer wayleaves

Risk of encroachment and construction of structures on the sewer wayleaves will affect the service providers because they will be unable to give services whenever there is a problem of sewer bursts or blockage. The impact is very high hence value 4.

7.4.2 Risk of farming using raw sewerage, this has potential of vegetation and soil contamination

Risk of farming using raw sewerage has potential of vegetation and soil contamination. Residents might divert raw sewage to firms during dry season. Once feed on the produced food might cause cancer. The impact is very high hence value 4.

7.4.3 Risks of Illegal Connections to the Sewer lines

The is common in the low income areas where residents connect to sewer lines 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. The impact is very high hence value 4.

7.4.4 Risk of Vandalism of Infrastructure

Manhole covers when made of steel or iron are prone to vandalism and sold to second hand metals to dealers. The impact is very high hence value 4.

7.4.5 Health Risks associated with burst Sewers

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. The impact is very high hence value 4.

7.4.6 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.

7.4.7 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. The impact is very high hence value 4.

7.5 Waste Water Treatment Works

7.5.1 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. The impact is very high hence value 4.

7.5.2 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 reported symptoms attributed to odours from treatment plants include:

- headache;
- alterations in mood;
- eye, nose, throat irritation;
- nausea;
- hoarseness;
- palpitations shortness of breath;
- stress;
- drowsiness;
- cough;
- nasal congestion.

Hydrogen Sulphide (H_2S) 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. The impact is very high hence value 4.

7.5.3 Invasion of Birds and Reptiles to the Waste Water Treatment Works

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).

During operation, 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. Certain animals including snakes may encroach the sewage treatment plants and other areas arising from overgrown vegetation. This will not only be a nuisance to the plants' operations but also pose safety threats to the immediate residents and commercial premises. The impact is very high hence value 4.

7.5.4 Increase in Social Vices

There if high likelihood of vandalism of the sewer equipment 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. The impact is very high hence value 4.

7.6 Positive impacts during decommissioning phase

Due to the national significance of this project, the likelihood of decommissioning is minimal, therefore impacts discussed below are almost unlikely.

7.6.1 Site Rehabilitation

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

7.6.2 Employment opportunities

In the event of decommissioning locals will gain employment from the various jobs that will arise.

7.6.3 Reduced environmental pollution

In the event of decommissioning, the odour from the sewerage and treatment plant will reduce environmental pollution if there was any.

7.7 Negative impacts during decommissioning phase

7.7.1 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.

7.7.2 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.

7.7.3 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

7.7.4 Solid waste generation

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.

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.

7.7.5 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 possess as danger to the workers if not handled well and with the correct PPE.

7.7.6 Noise and vibration

The demolition works will lead to significant deterioration of the acoustic environment within the Project site and the surrounding areas.

7.7.7 Interference with private property

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

7.7.8 Poor sanitation

Demolition of the sewer expansion networks will result to recurrence of the current poor sanitation status. This will attract breakout of diseases that arise from poor sanitation.

7.7.9 Dust emission

Dust will be emitted by moving vehicles and from the decommissioning works through digging and excavating of the tarmac surface.

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

This chapter presents the Environmental and Social Management Plan (ESMP) that will need to be implemented by the proponent/ contractor to prevent or reduce significant negative impacts to acceptable levels. The entire project components support infrastructure was considered when this ESMP was developed. Environmental management and social plans for all project phases have been outlined to cover:

- Design and Construction Phase;
- Operation Phase;
- Decommissioning Phase.

The following ESMP ***Table 8-1*** forms the core of this ESMP for the construction, operational and decommissioning phases of the proposed sewer project. The table details all necessary mitigation measures as well as the person responsible for implementing and monitoring such measures. The table should be used as checklist on site. Due to the magnitude of the project, compliance with the ESMP must be monitored periodically, reports prepared and provided at monthly site meetings during the construction phase, and quarterly during the operations and maintenance period as required in EMCA, Cap 387. Annual audits will be conducted during both the construction, operation and maintenance phases.

8.2 Cost of implementation the EMP

For effective implementation of the EMP, the project must establish an Environment, Health and Safety (EHS) unit that will be responsible for Project environmental Monitoring and Evaluation to ensure compliance to NEMA and Occupational Health and Safety. The project proponent will be required to produce periodic reports on project environment monitoring to be sent to the concerned agencies for information and supervision. The project proponent will be responsible for all costs of implementing the project's ESIA licence conditions, including the EMP and the actual costs of public involvement in the ESIA process. Hence, all costs proposed in the EMP below will be incurred by the project proponent who may transfer all to the contractor/ concessionaire except those of land acquisition and resettlement (Resettlement Action Plan Implementation budget).

The costs outlined are current costs mainly for project environmental monitoring and evaluation to ensure compliance to NEMA and OHS. To estimate future costs, an increase to cover annual inflation should be applied. The costs for actual activities should be included in the main bill of quantities of the project.

8.3 Project EMP Implementation

8.3.1 Role of Environmental, Health and Safety Experts

The ESIA process culminates with the formulation of a comprehensive Environmental and Social Management Plan. To ensure the latter is fully implemented, the Contractor should be required to hire Environmental, Health and Safety (EHS) and social experts who will continuously advise on EHS and social 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 Proponent through the supervising environmental and social experts. The EHS and social staff of the contractor will also be expected to fully understand the engineering and management aspects of the project for effective coordination of relevant environmental issues listed in the Environmental and Social Management Plan.

8.3.2 Project supervision

The supervising Engineer will ensure effective implementation of the environmental management plan. It is expected that the project supervisor will engage the services of an EHS experts who should master all environmental recommendations and the proposed action plans, timeframes and expected targets. The experts shall be the liaison persons between the contractor and the proponent on the implementation of environmental, health, safety and social concerns associated with the implementation of the project.

Table 8-1: Environmental and Social Management Plan – Design, Construction, Operation and Decommissioning Phases

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
Pre-Construction phase					
Seeking approvals from NEMA and Approval of plans from County and National Government	Delay in implementation of the Project due to objections and Court cases	• The Contractor to ensure all permits, certificates and licences have been obtained before any activities commencing on site and are enforced/ adhered to; • The Contractor keep all permits and licences required for the contract and for pertinent activities for the duration of the contract.	CRVWWDA & Contractor	Project Cycle	2,000,000.00
Land use management	Impact on the existing urban land use pattern	• Relate the project land use plan with the existing urban future plan and over to exclude some affected area	Project consultant, contractor	During designing time and construction	Nil if the proposed action is applied
Climate change and GHGs management	Climate change incident	• Search research findings on devising ways and means to reduce GHG emissions • Plan sewer systems to address ways and means of reducing GHG emissions without jeopardizing the beneficial effects of the project.	Contractor, CRVWWDA, local community and relevant stakeholders	Throughout project cycle	Nil cost its sharing of legal responsibility
Construction phase					
EMP management records	Risks of non-conforming to ISO 9001 on QMS and ISO 14001 on EMS	• The EMP should be kept on site; • Copies of all permits and licences should be kept on site; • All site specific plans prepared as part of the updated ESMMP; • All related environmental, social, health, safety management registers, and correspondence, including any complaints. Register of audit non-conformance reports and corrective actions. Accident and incident register.	Contractor	Project construction	No additional cost.
Setting out and clearance of Project Wayleave	Delay in Project implementation due to opposition from Project Affected Persons	Proponent to ensure that land acquisition is done within the provision of Land Act 2012 Prepare and Implement RAP recommendations before commencement of any works.	CRVWWDA & Contractor	Project implementation of the project.	At cost

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
Environmental & Social Training and Awareness	Risks of Environmental and Social degradation risks and occupational health and safety related accidents.	• The Contractor and sub-contractors shall be aware of the environmental requirements and constraints on construction activities contained in the ESIA Report EMP. • The Contractor will be required to provide for the appropriate Environmental Training. • Awareness as described in this ESIA – EMP, costs and programming. • An initial environmental awareness training session shall be held prior to any work commencing on site. (Number of trainings, attendance list of participants and training reports).	Contractor and all Workers.	Project construction	300,000.00
HIV/AIDS awareness and prevention campaign	Risks of Increased HIV and Aids transmission in the area.	• Contractor to develop appropriate training and awareness materials for Information and Education. • 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. ((Number of trainings, attendance list of participants and training reports).	Contractor and all Workers.	Project construction	300,000.00
Occupational Health and Safety	Risks of Accidents, Injuries or death of workers or community member.	• Provide construction workers with PPEs (gloves, safety shoes, overalls, reflectors, nose mask, ear muffs and helmets), • Provide temporary toilets and bathrooms for the construction workers at the work sites • Provide first aid kits accessible by the workers on need, • Isolate the site for access by the local communities during the construction for their safety and health	Contractor and Supervisor	Project Cycle	500,000.00

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
		• Contractor to provide a Healthy and Safety Plan prior to the commencement of works to be approved by the Resident Engineer.			
Noise and Vibration control from plant and equipment.	Risk to health and safety of community and workers	• The Contractor shall keep noise level within acceptable limits and construction activities shall, where possible, be confined to normal working hours in the residential, hospitals, schools 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 Resident Engineer. • The Contractor must adhere to Noise Prevention and Control Rules of April 2005.	Contractor and Supervisor	Project Cycle	No additional cost
Air Quality.	Air pollution can cause respiratory disorders to human.	• Workers will be trained on management of air pollution from vehicles and machinery. • Construction machinery will be maintained and serviced in accordance with the 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 200 metres of human settlement.	Contractor and Supervisor	Project Cycle	No additional cost
Local Labour / Employment	Delay in Project implementation due to opposition from community members within the project area..	• 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.	Contractor	Project Construction	At cost

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
Earth moving and excavations, vegetation clearance, channelling and site preparations.	• Temporary displacement of businesses. • Health and Safety risks. • Air pollution. • Social nuisance.	• Inform immediate communities or stakeholders of the activities. • Provide barrier tapes, 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 is potential for nuisance from dust generation, ensure earth moving is under dump conditions.	Contractor	Project cycle.	100,000.00
	• Vegetation cover loss/ destruction. • Loss of biodiversity	• Construction activities will be limited to Project sites/ routes, which already exist therefore limited destruction to vegetation cover.	Contractor	Project cycle.	At cost
	Top lying soil is lost	• Stock piling of top soil, construction material and wastes should be done only 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.	Contractor	Project cycle.	At cost
	• Public Health and safety risks. • Worker Occupational safety risks.	• Contractor to notify public the intent to cut sections of the road for safety precautions. • To provide signage and safety information in all work areas • To ensure compliance by workers with safety safeguards including the OHS, PPE and enforcement of application.	Contractor and Supervisor	Project cycle.	900,000.00
	Disruption of amenities (access roads, water, cables, electricity and driveways) causing inconveniences to the community.	• Notify other services providers and open sections that can be reinstated within the shortest period to avoid public disruption. • Mark the lines to avoid conflicts with other activities. • Install temporary barriers and signage.	Contractor and Supervisor	Project cycle.	To be determined
Wastes generation and disposal.	Risks of contaminating surface and underground water resources.	• Construction wastes to be removed for safe disposal. • Recycling to be encouraged. • Contaminated organic matter in the work areas to be isolated for safe disposal Material residuals to be	Contractor and Supervisor	Project Cycle	400,000.00

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
		disposed off in accordance with established NEMA regulations.			
Spoil Storage site.	Risks of solid waste mismanagement leading to pollution.	• Preferably to be located on land already cleared wherever possible. • People within the area 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.	Contractor and Supervisor	Project Cycle	No additional cost
Storage of fuel oils, lubricants, chemicals and flammable materials	Hazards of fire outbreak, oil and chemical spills.	• Follow specifications of the Occupational Health and Safety Act, EMCA 1999 and others in the development and operation of stores.	Contractor and Supervisor	Project Cycle	No additional cost
Sanitation issues resulting from both solid and liquid wastes on site.	Risks associated with water borne diseases exposed to community and workforce	• The Contractor shall follow 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 Resident Engineer 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.	Contractor	Project Cycle	At cost
Traffic management on site.	Risks of Accidents, Injuries or death of workers or community member.	• 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 sites.	Contractor and Supervisor	Project Cycle	200,000.00

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
		• Contractor to provide a traffic management plan during construction to be approved by the Resident Engineer.			
Contractor demobilization and site reinstatement.	Associated risks of environmental degradation.	• 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.	Contractor and Supervisor	Project Cycle	No additional cost.
Operational phase					
Risk of encroachment and construction of structures on the sewer wayleaves	People living within the area will encroach the wayleave and construct permanent and semi-permanent structures.	• Mapping and installation of beacons to which illustrate the width of the pipeline reserve. • Arrest and prosecute. • Regular inspection of the sewerage 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	NZOWASCO Area Chief	Project Operation	To be established
Risk of illegal connection to the Sewer and water pipeline	People living within the area might make illegal connections and by-pass.	• Seek official water connection by applying and paying connection fee. • This will require constant inspection by NZOWASCO officials to identify and repair leakages. • Arrest and prosecute. • Conduct public sensitization programs on importance not interfering with the sewerage and water pipeline.	NZOWASCO Area Chief and Police	Project Operation	To be established.

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
Risk of farming using raw sewage especially vegetables.	Diversion of sewage into farms during dry season.	• This will require constant inspection by NZOWASCO officials to identify farming. • Conduct public sensitization programs on importance not interfering with the sewerage and water pipeline. • Arrest and prosecute.	NZOWASCO Area Chief and Police.	Project Operation	To be established.
Risk of Sewer blockage and overflows to the environment	Manholes sometimes overflowing due to blockage or when not covered,	• Community awareness not to dump solids in manholes. • Regular cleaning of grit chambers and sewer lines to remove debris that may lead to sewer backups. • 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 • Development of an inventory of system components, with information including age, construction materials, and drainage areas served elevations.	NZOWASCO	Project Operation	To be established.
Risk of Vandalism of the infrastructure that is Manhole covers.	Stealing of man-hole covers to re-use or sell as scrap metals	• Common to manhole covers made using steel and concrete.	NZOWASCO	Project Operation	To be established.
Sludge handling and disposal	Sludge used as manure.	• Repair the roofs of the sludge drying beds to ensure quick drying of sludge and appropriate disposal to reduce odour emanating from wet sludge. • Workers to be educated and made aware on safe management, handling and application of the sludge cake. • 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.	NZOWASCO	Project Operation	To be established.
Air pollution from odour emanating from		• Ensure scum is appropriately disposed off or properly stabilized.	NZOWASCO	Project Operation	To be established.

Activity	Associated Impacts	Managements Actions	Responsibility	Frequency/Timing	Budget (KShs)
wastewater treatment works		• 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. • 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. • Plant trees especially bamboos and eco-friendly indigenous trees around the waste water treatment plant to limit exposure of neighbourhood to odour menace.			
Land and Soil Contamination	Raw sewage will contaminate land whenever it overflow or pipe bursts.	• The service providers 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.	NZOWASCO	Project Operation	To be established.

9 CONCLUSION AND RECOMMENDATIONS

The ESIA study has established that the proposed Sewerage System for Kimilili Town by Central Rift Valley Water Works Development Agency (CRVWWDA) is a worthy investment by the proponent and without a doubt will contribute significantly to the economic development of the country. This will be achieved through the prior discussed positive impacts namely:

1. Positive impacts during construction phase

(a) Creation of employment opportunities;
(b) Gains in the local and national economy;
(c) Transfer of skills;
(d) Provision of market and supply for building materials;
(e) Injection of money into the local economy;
(f) Creation of wealth to residents through direct and indirect business;
(g) Interaction of people from different communities.

2. Positive impacts during operation phase

(a) Creation of employment opportunities - Both direct and indirect employment opportunities will emerge during the operation phase. For the direct employment, people will be employed for the normal and continuous maintenance.
(b) Improved Sanitation - Currently the locals are using pit latrines and septic tanks. Therefore, the project will automatically lead to improved infrastructure.
(c) Improved Health and Hygiene of residents;
(d) Reduced cases of water borne related diseases;
(e) Growth of secondary businesses in the project area;
(f) Achieve economic benefit by saving some healthcare expenses, improving people's productivity and improving water resources management;
(g) Increased revenues for the service providers;
(h) Improvement in groundwater quality through preventing infiltration of sewerage from porous cesspits and pit latrines;
(i) Improve living conditions for targeted residents through achieving the above environmental benefits, upgrade their real estate values and contribute in alleviating poverty conditions through work opportunities in construction and operation of the project;
(j) Strengthen community participation in environmental protection through involving community-based organizations in project operation and mobilization activities;
(k) Land Value will go up;
(l) Corporate social responsibility (CSR) - The contractor will identify the needful areas in the project area and participate in CSR activities. Some of the noted problems in the area are unavailability of water, poor education and health infrastructure, employment, among others. Therefore, the contractor is expected to assist in any of these areas as part of CSR. Further, material sites such as borrow pits may serve as water collection points.

However, the ESIA study has established that the proposed project will also have some negative impacts. The negative environmental impacts that will result from establishment of the proposed project which include:

3. Negative impacts during Construction

(a) Disruption and loss of businesses;
(b) Vegetation clearing, soil erosion and siltation;
(c) Air quality pollution;
(d) Noise and excessive vibration;
(e) Water quality pollution;
(f) Hydrology within Project site;
(g) Interruption of existing infrastructure;

(h) Solid waste generation;
(i) Extraction and Use of Construction Materials;
(j) Occupational health and safety risks;
(k) Spread of communicable diseases and HIV/AIDS infection;
(l) Gender Based Violence;
(m) Cultural changes;
(n) Gender and equality biases;
(o) Sexual Exploitation/Child Abuse.

4. Negative impacts during Operation

(a) Risk of encroachment and construction of structures on the sewer wayleaves;
(b) Risk of farming using raw sewerage, this has potential of vegetation and soil contamination;
(c) Risks of Illegal Connections to the Sewer lines;
(d) Risk of Vandalism of Infrastructure;
(e) Health Risks associated with burst Sewers;
(f) Risks of Water Pollution from overflowing and blockage of Sewers;
(g) Land and Soil Contamination.

The proponent of the proposed project shall be committed to putting in place several measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project. It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the Environmental Management and Monitoring Plan as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects in Kenya. It is expected that the positive impacts that emanate from such project shall be maximized as much as possible as exhaustively outlined within the report.

Considering the positive socio-economic and environmental benefits which will accrue because of the proposed development and the ESIA study having found no major impacts to arise from the development, it is our recommendation that the project be allowed to proceed on the understanding that the proponent will adhere to the mitigation measures recommended herein and will further still implement the proposed Environmental Management and Monitoring Plan to the letter. Kenya as a country has a big shortage of such project developments. Therefore, the construction of the proposed project goes a long way in solving part of the existing challenges experienced water and sewerage sector.

10 APPENDICES

- Appendix A: Project Location and Layouts
- Appendix B: Lead Expert CV and NEMA Certificate
- Appendix C: EIA and Social Field Tools
- Appendix D: Public Meetings List of Attendants and Minutes
- Appendix E: Pictorial Presentation

Appendix A Project Location and Layouts

Appendix B Lead Expert CV and NEMA Certificate

Appendix C EIA and Social Field Tools

Appendix D Public Meetings List of Attendants and Minutes

Appendix E Pictorial Presentation

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