

ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT



Environmental Impact Assessment Study Report

Mrs. Margaret Wahu Karimi
Proposed Mixed Development
L. R. No. Donyo Sabuk/Komarock Block 1/89438
Joska – Kamulu Location
Matungulu Sub-County – Machakos County

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ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT

**Proposed Mixed Development Project
L.R. No. Donyo Sabuk/ Komarock Block 1/ 89438
Joska – Along Kangundo – Nairobi Road
Matungulu Sub-County, Machakos County**

Prepared on behalf of:

**Mrs. Margaret Wahu Karimi
P.O. Box 609-00520
NAIROBI**

CERTIFICATION

This Environmental Impact Assessment Study Report has been prepared on behalf of MRS. MARGARET WAHU KARIMI, herein thereafter referred to as “the proponent” by Mr. Daniel K. Kiige, a NEMA Registered Lead Expert, and Environmental Expert for Hiagro East Africa, a NEMA Registered Firm of Experts. This report has been done with reasonable skills, care and diligence in accordance with the Environmental Management and Coordination Act, 1999 and the Environmental Impact Assessment and Audit Regulations, 2003.

We, the undersigned, certify that the particulars given in this report are correct to the best of our knowledge.

Lead Expert: KIIGE Daniel K.
NEMA Registered Lead Expert; MA (EPM) - UoN - Nairobi, Kenya; EMS/ISO 14001 Lead Auditor (SGS - Kenya);, BSc (Env. Sci) - Egerton, KENYA.

Signature..... Date.....

Proponent **MRS. MARGARET WAHU KARIMI**
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TECHNICAL TEAM

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Nelson K. Mwaura	Lead Architect - Arcon Design Link
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Ariemba Bob Nyakwara	Project Engineer
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EXECUTIVE SUMMARY

Introduction

KIIGE Daniel, herein thereafter referred to as *the EIA expert* was approached by MRS. MARGARET WAHU KARIMI, herein thereafter referred to as the proponent to carry out an Environmental Impact Assessment study for the proposed mixed development on L.R. No. Donyo Sabuk/ Komarock Block 1/ 89438 along Kangundo Road – Joska, Machakos County. This was to comply with the Legal requirements stipulated in the Environmental Management and Coordination Act, 1999, EMCA (Amendments) 2015 and the subsequent Legal supplement of 2003.

More so it is a way of promoting benign environmental management for sustainable development. The Firm of Experts is registered by the National Environment Management Authority (NEMA) to carry out environmental impact assessments and audits.

Project Description

The proponent aims to construct and manage a mixed development on 0.444 Ha in two phases. Phase one comprises of one block of both commercial and residential units as follows:

- i. Ground Floor – 10,561 sqft commercial space and 13,455 sqft parking space
- ii. 1st Floor – 10,571 sqft Commercial space
- iii. 2nd Floor – 10,967 sqft commercial space
- iv. 3rd Floor – 10,967 sqft commercial space
- v. Mezzanine Floor 1 to Mezzanine Floor 5 – 8 No. One Bedroom and 5 No. Two Bedroom Residential Units per floor. (Total 40 No. One Bedroom and 25 No. Two Bed Room Units).
- vi. 4th Floor to 8th Floor – 15 No. One Bedroom and 10 No. Two Bedroom Residential Units per floor. (Total 75 No. One Bedroom and 50 No. Two Bedroom Units).

Since the project site is not connected to a sewer line, the proponent shall source for an effluent treatment plant adequate for the proposed mixed use development.

The buildings are well presented in the architectural drawings attached herein. The planning application in respect of the project has been submitted for approval by the Machakos County Government and other relevant lead agencies.

Legislation, Institutional and Legal Framework

The major laws governing such activities as the proponent is interested are:

1. Constitution of Kenya
2. Environmental Management & Co-ordination Act (Amendment) 2015
3. Environmental Management and Co-ordination Act (EMCA), 1999
4. Environmental (Impact Assessment and Audit) Regulations, 2003
5. Occupational Safety and health Act, 2007 and all its subsidiary legislations
6. The Land Act, 2012
7. Public Health Act Cap. 242
 - Part ix (Section 115, Section 116, Section 118)
 - Part xi (Section 129, Section 130);
 - Part xii (Section 136)
8. Physical Planning Act (Cap 286)
(Section 29; Section 30; Section 36)
9. Water Act (Cap 372)
Part II (Section 18 and Sub-section 3), Section 73, Section 75, Section 76,
Section 77)
10. Occupiers Liability Act, cap 34

Summary of Positive Impacts

- ◆ Provision of affordable residential units and commercial space for businesses.
- ◆ Creation of Employment Opportunities construction workers during the construction phase of the project
- ◆ Provision of Market for Supply of Building Materials because the project will require supply of large quantities of building materials most, of which will be sourced locally.
- ◆ Increased Business Opportunities for small scale traders such as food vendors around the construction site
- ◆ Provision of modern buildings with new and infrastructure to residents.

- ◆ Availability of Employment Opportunities at the project as management agents, caretakers, cleaners, security personnel and technicians.
- ◆ Contribution towards the national and county government revenue earnings.
- ◆ Improved Security in the surrounding area

Summary of Negative Impacts

- ◆ Extraction and Use of Building Materials from natural resource banks e.g. quarries
- ◆ During construction, the project will generate substantial quantities of dust at the construction site and its surrounding.
- ◆ Increase in traffic on Kangundo road during construction, which in turn leads to increased air pollution through CO₂, NO_x vehicle emissions.
- ◆ The construction works, delivery of building materials by heavy trucks and the use of machinery/equipment including bulldozers, generators, metal grinders and concrete mixers will contribute high levels of noise and vibration within the construction site and the surrounding area.
- ◆ Risks of Accidents and Injuries to Workers due to the intensive engineering and construction activities
- ◆ Large quantities of solid waste (soil) will be generated as a result of excavation of the site.
- ◆ Increased Energy Consumption that is in consumption of fossil fuels (mainly diesel) to run transport vehicles and construction machinery.
- ◆ Increased water use since construction activities will require large quantities of water.
- ◆ Solid Waste Generation during project operation
- ◆ Increased Energy Consumption during occupation of the proposed project
- ◆ Increased water use through conduction of domestic activities such as cleaning in the proposed project facilities
- ◆ Increased traffic from the residents and commercial activities during operation

Summary of Proposed Mitigation Measures

- ◆ Efficient sourcing and Use of Raw Materials through accurate budgeting and estimation of actual construction requirements
-

- ◆ Minimization of Run-off through terracing and levelling the project site to reduce run-off velocity and increase infiltration of rainwater into the soil
- ◆ Minimization of Construction Waste by ensuring that the amount of construction materials left on site after construction is kept minimal, use of durable, long- lasting materials that will not need to be replaced as often, Provision of facilities for proper handling and storage of construction materials, purchase of perishable construction materials such as paints incrementally, use of building materials that have minimal packaging and use of construction materials containing recycled content
- ◆ Dust emission during construction will be minimized through strict enforcement of onsite speed controls as well as limiting unnecessary traffic
- ◆ Ensuring that construction vehicles preferably deliver materials during off-peak hours when traffic volume is low
- ◆ Noise and vibration will be minimized in the project site and surrounding areas through sensitization of construction truck drivers to switch off vehicle engines while offloading materials avoid gunning of vehicle engines or hooting especially
- ◆ Construction machinery shall be kept in good condition to reduce noise generation
- ◆ Adherence to the occupational health and safety rules and regulations stipulated in Occupational Safety and Health Act, 2007
- ◆ Ensuring responsible electricity use at the construction site through sensitization of staff to conserve electricity by switching off electrical equipment or appliances when they are not being used
- ◆ The proponent shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water usage
- ◆ Ensuring Efficient Solid Waste Management
- ◆ The proponent will ensure that there are adequate means for handling the large quantities of sewage generated by the buildings being directed to the respective bioreactors
- ◆ The proponent plans to install an energy-efficient lighting and heating system for the project
- ◆ The proponent will install water-conserving automatic taps and toilets

Public Participation and Consultation

The EIA study entailed consultation with the identified stakeholders whose recommendations were taken into consideration during the preparation of the EIA study report. The negative and positive impacts of the proposed project were discussed with residents and their representatives in the neighbourhood of the site. The approach used comprised interviews, focus group discussions and administration of structured questionnaires.

Conclusion

The project will play an important role in increasing the number and quality of commercial and residential facilities in the area, country and regionally, however to greatly work in sync with the environment and stakeholders in order to ensure project sustainability, the proponent should proceed with the project with the prescribed mitigation measures. Constant monitoring of the said aspects (impacts and mitigation) through close follow-up and implementation of the recommended Environmental Management and Monitoring Plans will also ensure its longevity and avoid conflicts between the project and stakeholders or between it and nature. In relation to the proposed mitigation and environmental management and planning measures that will be incorporated during construction and operation phases; and the developments' input to the proponent and the general society, the proposed project is considered beneficial and important. Major concerns should nevertheless be focused towards minimizing the occurrence of impacts that would degrade the general environment.

On the strength of the aforesaid, it is hereby recommended that the project be granted the required approval and an EIA license as appropriate.

Summary of Environmental Management Plan

Issues of concern	Mitigation Measures	Responsibility
Soil erosion	<ul style="list-style-type: none"> • Control earthworks & compact loose soils • Install drainage structures properly • Landscaping • Ensure management of excavation activities • Control activities especially during rainy conditions • Provide soil erosion control and conservation structures where necessary. • Efficiency of erosion control measures 	Proponent Monitoring: Inspections and routine maintenance
Air pollution through dust and gaseous emissions	<ul style="list-style-type: none"> • Control speed and operation of construction vehicles • Install dust screens around the construction site • Prohibit idling of vehicles • Water should be sprayed during the construction phase of excavated areas • Regular maintenance of construction plant and equipment • Engage sensitive construction workers 	Proponent Monitoring: inspections, air measurements
Noise pollution	<ul style="list-style-type: none"> • Sensitize drivers of construction machinery. • Construction activities to be restricted to daytime • Workers in the vicinity of or involved in high-level noise to wear safety & protective gear 	Proponent Monitoring: inspections, noise surveys
Oil pollution	<ul style="list-style-type: none"> • Proper storage, handling and disposal of new oil and used oil wastes • Maintain equipment to avoid leaks • Maintenance of construction vehicles should be carried out in the contractors yard (off the site) 	Proponent Monitoring: Observation
Road safety	<ul style="list-style-type: none"> • Enforce speed limits for all vehicles accessing the site • Provide bill boards around the site to notify all stakeholders about the development • Develop a proper entry and egress plan from the highway 	Proponent and traffic police
Public health and occupational safety	<ul style="list-style-type: none"> • Train workers on occupational health and safety • Provide full protective gear & workmen's compensation cover in addition to the right tools and operational instructions & manuals • Adopt sound waste management system to ensure proper solid waste disposal and collection facilities • Ensure effective wastewater management • Sensitize residents on environmental management • Design of sewerage system should be as provided in the plans • Engage the services of qualified personnel and/or 	Proponent Monitoring: Observation

	<p>ensure training</p> <ul style="list-style-type: none"> • Ensure wholesome water is available for drinking • Make health and safety awareness a priority • Post clear warning signs e.g. ‘No unauthorized use of machines’, ensure there are guards on moving parts e.t.c • Provide fully equipped First Aid kits & train staff on its use • Sensitize residents on environmental management 	
Fire Safety and preparedness	<ul style="list-style-type: none"> • Install fire fighting equipment • Conduct training on fire fighting, evacuation and emergency response • Sensitize the workers on fire risks i.e. conduct regular fire drills • Provide emergency numbers at strategic points 	<p>Proponent</p> <p>Monitoring: inspections</p>
Record Keeping	<ul style="list-style-type: none"> • Collection and analysis of relevant environmental, health and safety data at the site 	<p>Proponent</p> <p>No cost implications</p>
Internal Audits	<ul style="list-style-type: none"> • Monitoring will involve measurements, observations, evaluations assessment of changes in waste management Noise levels, workers safety e.t.c. 	<p>Proponent</p>
Contractors lay down area	<ul style="list-style-type: none"> • Special attention should be paid to the sanitary facilities on site. • Garbage should be disposed off periodically and at approved dumpsites 	<p>Proponent</p> <p>Monitoring: inspections</p>

Monitoring

A comprehensive monitoring plan outline will be developed covering the implementation of the project related impact and compliance to operational procedures.

The parameters include:

1. Air quality and emission
2. Nature of industrial activity.
3. Rate and quality of waste discharge
4. Hazardous waste generation handling, storage and disposal
5. Other necessary parameters.

ACRONYMS

°C	Degrees Celsius
CBD	Central Business District
CLPs	Consents, Licenses and Permits
CSR	Corporate Social Responsibility
DRDS	Domestic Refusal Disposal Services.
EA	Environmental Audit
EAC	East African Community
EAM	Environmental Management Company
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Co-ordination Act
EMP	Environmental Management Plan
HCFC	Hydrochlorofluorocarbon
HWM	Household Waste Management
KBS	Kenya Bureau of Standards
KM	Kilometers
KPLC	Kenya Power and Lighting Company
KVA	Kilo Volts Amperes
NEC	National Environmental Council
NEMA	National Environment Management Authority
NWSC	Nairobi Water and Sewerage Company.
OH&S	Occupational Health and Safety
OSHA	Occupational Safety and Health Act, 2007
PCs	Private Companies.
ppm	parts per million
SHE	Safety Health & Environment
SWM	Solid Waste Management
ToR	Terms of Reference
UNEP	United Nations Environmental Programme
WRMA	Water Resources Management Authority

ACKNOWLEDGMENT

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KIIGE D. K.

OCTOBER, 2019

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1. INTRODUCTION

1.1. Rationale for an Environmental Impact Assessment

Industrialization has been embraced by many developing countries as a means of achieving structural transformation of their economies. In Kenya industrialization has recently been embraced as a strategy for economic development, employment creation and poverty eradication.

As such, a policy framework was developed in 2008 for achieving industrialization by the year 2030 dubbed “Vision 2030”. The major departure from previous policies on industrialization is the encouragement of specifically selected industries through a broad array of support by the government over a 26-year period, by which time Kenya will have achieved industrialized status. The present policy framework considers housing industry as the leading sector for addressing the development challenges faced by the country.

Further the Presidency in 2017 came up with “the Big Four” agenda where housing is one of the key pillars. The Government of Kenya has defined the "Big Four" transformation agenda for the Nation which identifies Four Priority initiatives to be implemented over the next five years 2017 – 2022, core among them the Delivery of 500,000 Affordable Housing Units. The State Department for Housing and Urban Development has been charged with the mandate of structuring and delivering the Affordable Housing Programme covering major urban areas across the country and will incorporate innovative, cost effective and efficient delivery models. This will be done hand in hand with the private sector.

Industrialization goes hand in hand with infrastructural development. Without infrastructures such as housing industrialization will not be supported.

The housing sector has in the last few years experienced a surge which experts refer to as “construction boom”. Joska area and Machakos County in large, part of the ever expanding Nairobi City Suburbs, has not been left behind in this boom and therefore there is construction almost everywhere.

Economic, social and environmental change is inherent to development. Whilst development aims to bring about positive change it can lead to conflicts. In the past, the promotion of economic growth as the motor for increased well-being was the main development thrust with little sensitivity to adverse social and/or environmental impacts.

The need to avoid adverse impacts and to ensure long term benefits led to the concept of sustainable development. This concept has become accepted as an essential feature of development with the aim of increasing well-being and greater equity in fulfilling basic needs for this and future generations.

In order to predict environmental impacts of any development activity and to provide an opportunity to mitigate against negative impacts and enhance positive effects, the environmental impact assessment (EIA) procedure was developed in the 1970s. An EIA may be defined as: *a formal process to predict the environmental consequences of human development activities and to plan appropriate measures to eliminate or reduce adverse effects and to augment positive effects.*

EIA thus has three main functions:

- To predict problems,
- To find ways to avoid them, and
- To enhance positive effects.

Due to the unprecedented rate of environmental degradation in Kenya, the government realized the need to curb the same and this led to the enactment of the Environmental Management and Coordination Act, 1999. The Act requires among other things that an Environmental Impact Assessment (EIA) must be conducted on various categories of projects as particularly outlined in the Second Schedule and section 58 of the Act.

1.2. The Proposed Project

The proponent aims to construct and manage a mixed development on 0.444 Ha in two phases. Phase one comprises of one block of both commercial and residential units as follows:

- Ground Floor – 10,561 sqft commercial space and 13,455 sqft parking space
- 1st Floor – 10,571 sqft Commercial space
- 2nd Floor – 10,967 sqft commercial space
- 3rd Floor – 10,967 sqft commercial space
- Mezzanine Floor 1 to Mezzanine Floor 5 – 8 No. One Bedroom and 5 No. Two Bedroom Residential Units per floor. (Total 40 No. One Bedroom and 25 No. Two Bed Room Units).
- 4th Floor to 8th Floor – 15 No. One Bedroom and 10 No. Two Bedroom Residential Units per floor. (Total 75 No. One Bedroom and 50 No. Two Bedroom Units).

1.2.1. Project Location

2.

The Proposed Project is a Mixed Use Development on L.R. No. Donyo Sabuk/ Komarock Block 1/89438 which is along Kangundo Road, Joska, Matungulu Sub-County, Machakos County.

Point ID	Latitude	Longitude
1	S1° 28' 3889"	E 37° 10' 0365"
2	S 1° 28'4029'	E 37° 10' 0070"
Projection		Datum

Table 1.1 Proposed Project Site Coordinates

1.2.2. Land Tenure, Use, Ownership and Management

The property under reference is under agricultural use and the proponent has initiated a change of use to mixed use development (Residential and Commercial). The land is on freehold. The land is registered in the name of Mrs. Margaret Wahu Karimi.

1.2.3. Project Design

The proposed project will entail the development of mixed use establishment that will include: retail and commercial establishments in the form of shops and supermarkets. The commercial development will help to shield the residential units and other components from Kangundo road thus keeping them away from traffic pollution and road noise, and will therefore allow the option of natural ventilation in the buildings, as well as creating pleasant public spaces.



Plate 1-1: Architectural Impression of proposed project

1.3 Need for the project

There is a glaring gap between the demand and availability of mixed development and associated facilities in various sections of Nairobi City, surrounding areas and satellite towns. This has been largely so because most of the more recent large scale developments in areas near the Nairobi metropolitan have tended to focus more on high-end developments.

The conceived project is designed to be within character of the current development trend for Matungulu and neighbouring satellite towns for Nairobi, where this survey revealed that such developments are guaranteed of attracting the desired clientele. A survey sponsored by the proponent has established that demand exists for such development and that the target clientele would cherish an environment that meets the following criterion:

- A serene environment neighbouring the city
- Proper security
- An environment that will allow occupants to interact but with strict rules regarding
 - Individual Privacy
 - Security of residents

The need therefore exists for providing flexible, modern and cost effective homes as the proposed development.

1.3.1 National Housing Policy and Housing Needs in Kenya

In August 2003, the government of Kenya through a Sessional Paper spelt out a Housing Policy whose overall goal was to facilitate the provision of adequate shelter and healthy living

environment at an affordable cost to all socio-economic groups in Kenya in order to foster sustainable human settlements. The aim is to minimize the number of citizens living in shelters that are below the habitable living conditions.

To alleviate the huge shortfall of urban housing mentioned above and to curb the mushrooming of informal settlements/slums, various interventions and strategies have to be adopted. In the Policy Paper, the government correctly accepts the fact that it cannot meet the housing shortfall on its own and that the best policy is to encourage the private sector (like the proponent) to chip in while the government provides an enabling environment for development. The government will provide an enabling environment by doing the following:

- Facilitating the supply of serviced land at affordable prices in suitable locations
- Expanding and improving infrastructure facilities and services
- Using research findings as well as innovative but cheap conventional building materials and technologies to improve production of commercial units.
- Harmonizing the Banking Act, the Building Society Act, the Insurance Act and the various Acts that have so far proved to be a hindrance to the sourcing of housing finance.
- Generally easing the path of funds from the private investor/government to the development project.
- Issuing workable guidelines on Estate Management and maintenance.

The promotion of this development is therefore well within the government current and long term policies of ensuring improved employment standards for all by 2030 (Vision 2030).

1.4 Purpose of the Study

The purpose of the study is to incorporate the potential environmental (physical, ecological and cultural/socio-economic) concerns and address them adequately at the inception (design) and occupation stages in order to guarantee sustainability in the operational phase of the flat. The study is expected to raise both the potentially positive and negative impacts likely to emanate from the proposed project.

Integrating Sustainable Environmental Management principles in the planning and implementation processes of any proposed projects is a milestone in reducing/mitigating conflicts as well as enhancing control and revitalization of the much-degraded environment.

1.5 Scope of EIA Study

The study has been conducted to evaluate the impacts of the proposed Housing Development resulting from construction and operations.

The EIA project report includes an assessment of impacts of the construction and operations on the following: -

- A review of the policy, legal and administrative framework
- Description of the proposed project
- Baseline information (Biophysical and Socio-Economic environment)
- Assessment of the potential environmental impacts of the proposed project on the biophysical, socio-economic and cultural aspects.
- Development of the mitigation measures and future monitoring plans.
- Occupational Health and Safety –OHS
- The study also assesses the impacts of the proposed development on the environment in accordance with Kenya Environmental Management and Coordination Act, of 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003.

1.6 Terms of Reference (TOR)

The project assessment investigations and analysis of the anticipated environmental impacts of the proposed development in line with terms of reference stipulated in the Environmental (Impact and Audit) regulations 2003 and in particular part II S 7[1] and which are listed below.

- (i) Nature of project.
- (ii) The location of the project including the physical environment that may be affected by the project's activities.
- (iii) The activities that shall be undertaken during the design of the project, construction and operation.
- (iv) The potential environmental impacts of the project and mitigation measures to be taken during and after the implementation of the project.
- (v) An action plan for prevention and management of possible accidents during the project cycle.
- (vi) A plan to ensure the health and safety of the workers and the neighboring communities.
- (vii) The economic and social cultural impacts to local community and the nation in general.

- (viii) Examination of the project alternatives
- (ix) The project budget.
- (x) Any other information that the proponent may be requested to provide by NEMA.

1.7 Methodology

Various data collection and analyses techniques were used in the assessment:

1.7.1 Desk Review

Deskwork provided a detailed description of the project with respect to spatial coverage, preliminary design layout, magnitude, implementation schedules and costs as well as human resources. Relevant documents were reviewed to obtain information on the baseline information in general but specifically at the project site. This documentary review provided further understanding the project design (site plan and architectural drawings), land use, local micro-environmental conditions, data on demographic trends, land use practices, development strategies and plans (local and national) as well as the policy and legal documents among others. Others included area maps, Development Plans of the Nairobi City and its metropolis, National Development and Economic Surveys, relevant legislations, regulations and guidelines and standards.

1.7.2 Field Assessment

Physical evaluation of the project area was carried out with specific focus on landform trends, land use patterns, biodiversity, natural resources, hydrology and climatic variations. This was also an evaluation of the current environmental status with respect to physical, biological and socio-cultural perspectives. It was a systematic field inspection backed with available documentation and direct interviews. Field evaluation was planned to enable determination of the exact physical environmental features to be affected within the proximity of the project site. In addition to identifying the potential positive and negative impacts, field assessments contributed understanding the proposed works to be undertaken.

The field survey adopted various techniques of baseline data collection on the existing environmental conditions, namely:

- Field observations and recordings including photography the project site and its vicinity.
- Use of checklists for determining potential environmental impacts of the proposed project.

- Consultations and public participation within the neighbourhood of the project site.

Detailed field observation assessment was undertaken to enable determination of the exact socio-economic activities within the proximity of the project site. Among the broad focal areas for which observation was done included: settlement patterns, land-use, commerce, trade and industry among others. Checklists were used along with observations to check on possible environmental impacts of the project would have on the environment during both construction and operational phases. In this assessment, checklists were utilized to: facilitate identification of potential environmental impacts; provide a means of comparing the predicted environmental impacts; indicate the magnitude of both positive and negative environmental impacts; indicate possible adverse environmental impacts that are potentially significant but about which sufficient information can be obtained to make a reliable prediction; and Indicate negative potential environmental impacts in the project area, which merit mitigation measures and monitoring during project implementation.

1.7.3 Public and Stakeholders Engagement

Structured stakeholder engagement was undertaken in the neighbourhood of the proposed project site to capture the views and concerns of interested and affected parties. The engagement process entailed face to face meetings / interviews.

1.7.4 Data Collection, Analysis

The process of data collection was undertaken as follows:

- **Preliminary assessment of the site:** where the experts visited the site to know the location.
- **Screening:** This is the initial phase of any EIA process. It involves the determination of whether or not an EIA assessment is required for a particular development activity.

Determination in the proposed project depended on the following aspects but not limited to:

- The sensitivity of the area likely to be affected;
- Public health and safety;
- The possibility of uncertain, unique or unknown risks;
- The possibility of having individually insignificant but cumulatively significant impacts;
- Whether the proposed activity affects protected areas, endangered or threatened species and habitats;

From the above, the proposed project was seen to require an Environmental Impact Assessment since construction activities of such magnitude are expected to give forth both negative and positive effects to the environment and ultimately contribute to an increased waste generation both in the construction and occupational phases. This stage also involved activities such as:

- a) Getting a comprehensive site description that includes: Location of the proposed project, the soils and geology of the proposed site, water resources available on site, drainage system evident on site, climatic conditions of the proposed location and its vicinity, vegetation on site, land use systems on site and its vicinity, population characteristics of the region holding the proposed site, infrastructure at the site and justification for selection of the site.
 - b) Getting detailed information on: The nature of the proposed construction activities, the materials to be used in the construction activities on site and the expected project outputs including waste generation
- Collection of Baseline Data:** Data collection involved activities such as desktop assessment and discussion with the proponent, observation, detailed physical inspection of the proposed site and the surrounding areas to determine the present and anticipated impacts of the proposed project, assessment of the approved structural and technical drawings for the proposed project development (housing units) and development of a photo log. The data obtained

was used to assess potential impacts on health, safety, environment and the community surrounding the proposed site location. From the obtained data, environmental, health, safety and social concerns were identified in relation to the proposed project location and mitigation measures proposed for the negative impacts, while enhancement measures proposed for the positive impact. Photography was used to capture salient features and baseline conditions in the project site and its neighbourhood. The photos were used to define existing features in the project area and identify soils and floral species in the area.

- **Data Analysis and Evaluation of Alternatives:** use of checklists and the threshold limits were used in data analysis; while the proposed site location, technologies to be employed, product mix, scale of construction, potential environmental impacts, capital and operating costs, suitability under local conditions, and institutional, training, and monitoring requirements were considered in the evaluation of alternatives. The proposed project's impacts were identified using a developed checklist, public consultation information, literature and professional knowledge. Impacts were first distinguished as either positive or negative. The proposed project's negative impacts were analysed to denote their significance based on their characteristics and this was also impacts per project phase. Significance was judged based on their capacity to change baseline conditions beyond acceptable standards or legislative provisions. A qualitative scoring matrix was used to give a value/score of each impact on the environment
- **Consultation and Public Participation:** here, stakeholders, that include the neighbors to the proposed site were interviewed and asked to fill in questionnaires, in order to get their views, expectations, projected economic and social effects regarding the proposed project activities and location. These findings were then analyzed and incorporated in this ESIA Study Report.
- **Preparation of the EIA Study Report:** this Environmental Impact Assessment study report was then prepared by approved and registered (by NEMA) EIA experts, who are familiar with the provisions of the Environmental Management and Coordination Act (EMCA), 1999, EMCA (Amendments), 2015 and other relevant regulations and laws of Kenya as indicated in the Legal framework.

2. LEGAL AND LEGISLATIVE FRAMEWORK

2.1 Introduction

Presently environmental legislation in Kenya is provided in more than 77 statutes. In order to provide a structured approach to environmental issues and management, EMCA was enacted on 14th January 2000 as a legal framework that contains provisions for environmental Management of proposed and ongoing projects in Kenya. To operationalize the Act, various administrative structures were established. These include NEC, NEMA, THE PCC, Provincial and District Environmental Committees, the SERC and the National Environment Tribunal. The law has made provisions for the establishment of the National Environmental Management Authority (NEMA), which has the statutory mandate to supervise and co-ordinate all environmental activities. The Environmental Management and Co-ordination Act, 1999, and the Environmental (Impact Assessment and Audit) Regulations, 2003, are the legislation that governs Environmental Impact Assessment (EIA) studies. Policies and legislation highlighting the legal and administrative requirements pertinent to this study are presented below.

2.2 Kenya Legal Framework

2.2.1 The Constitution of Kenya

Promulgated on the 27th of “August 2010, the constitution of Kenya in its preamble declares that the people of Kenya are respectful to the environment, which is their heritage and they are determined to sustain it for the benefit of future generations.

The constitution which is based on the bill of rights as its backbone, states in article 42 that every person has a right to a clean and healthy environment and subsection 1 adds that this includes the right to protect environment for the benefit of present and future generations through legislative and other measures. Article 43 follows declaring economic and social rights of every Kenyan and they include in subsections: (a) the right to the highest attainable standard of health, which includes the right to health care services, including reproductive health care and (d) the right to clean and safe water in adequate quantities. Section 2 of article 43 adds that no one shall be denied emergency medical care.

The constitution also endorses the national land policy and chapter 5 which deals with land and environment states principally in article 60 that land in Kenya will be held, used and managed in a manner that is equitable, efficient, productive and sustainable. The principles are outlined in subsections of article 60 and article 61 declares that all land in Kenya belongs to the people of Kenya collectively and subsection 2 classifies land to be as either public, community or private and thus it's important to establish in which of these the project lies. The national land commission is established in article 67 and its main function is to manage land on behalf of national and county governments.

Part 2 of chapter 5 deals with the environment and natural resources and article 69 section (1) subsection (a) states that the state will ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits. The following subsections give regulations in terms of forest cover, biodiversity, cultural resources, indigenous knowledge, systems for environmental impact assessment and prevention of activities that may harm the environment. Section 2 states that every person has a duty to cooperate with state organs and other persons, to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources. Article 70 deals with enforcement of environmental rights and everyone who feels their right to a clean and healthy environment has been denied has the obligation to go to court to seek redress. Article 71 and 72 deal with agreements relating to natural resources and legislation relating to the environment respectively, where parliament is given this authority.

- **National Environmental Action Plan (NEAP)**

According to the Kenya National Environmental Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programmes that disregarded environmental sustainability. Established in 1990, the NEAP's effort was to integrate environmental considerations into the country's economic and social development. Under the NEAP process EIA was introduced and among the key participants identified were the industrialists, business community and local authorities.

- **The Brundtland Commission of (1987)**

The Brundtland Commission addresses the environmental aspects of development. It has emphasized on sustainable development that produces no lasting damage to the biosphere and to particular ecosystems. In addition to environmental sustainability is the economic and social sustainability. Economic sustainable development is development for which progress towards environmental and social sustainability occurs within available financial resource.

- **Policy Guidelines on Environment and Development**

Among the key objectives of the Policy Paper on Environment and Development (Sessional Paper No. 6 of 1999) are to ensure that from the onset, all development policies, programmes and projects take environmental considerations into account and to ensure that an immediate environmental impact assessment (EIA) report is prepared for any housing venture or other development before implementation among others.

Under this paper, broad categories of development issues have been covered that require sustainable approach. The policy recommends the need for enhanced re-use/recycle of waste including wastewater, use of low non-waste technologies, increased public awareness and appreciation of clean environment. It also encourages participation of stakeholders in the management of wastes within their localities.

- **National Policy on Water Resources Management**

While the National Policy on Water Resources Management and Development (1999) enhances a systematic development of water facilities in all sectors for the promotion of the country's socio-economic progress, it also recognizes the by-products of these processes as wastewater. It, therefore, calls for the development of appropriate sanitation systems to protect people's health and water resources from pollution.

2.3. The Water Act, 2002

The Kenya Water Act of 2002 was enacted to ensure equitable and sustainable use of water resources in the country. It establishes the Water Resource Management Authority to manage water resources in the country that are vested in the state.

The Minister also formulates, and publishes in the Gazette, the national water resources management strategy in accordance with which the water resources of Kenya are being managed, protected, used, developed, conserved and controlled, the Water Resources Management Authority (WRMA) in turn formulate a catchment management strategy through which water catchment areas are managed.

WRMA may also with approval from the Minister declare an area to be a protected area where it is satisfied that special measures are necessary for the protection of a catchment area or part thereof and the Authority may impose such requirements, and regulate or prohibit such conduct or activities, in or in relation to a protected area as the Authority may think necessary to impose, regulate or prohibit for the protection of the area and its water resources. Schemes are categorized hierarchically with state schemes taking precedence over community schemes and by notice in the Kenya gazette land may be acquired for purposes of a state scheme under means prescribed in the law as to how land may be acquired. Community water resources projects are only allowed if the proposed project is approved by the persons owning or occupying at least two-thirds of the particular area concerned in the project; and provision is made by the project for an adequate alternative supply of water to be supplied to permit holders likely to be adversely affected and unable to benefit from the scheme.

In term of water work permits will be required for the following purposes except in state schemes; any use of water from a water resource (except as provided in section 26); drainage of any swamp or other land; the discharge of a pollutant into any water resource; any purpose, to be carried out in or in relation to a water resource, which is prescribed by rules made under the Act to be a purpose for which a permit is required. Further exceptions for permit requirement are for;

1. the abstraction or use of water, without the employment of works, from or in any water resource for domestic purposes by any person having lawful access thereto;
2. any development of ground water, where none of the works necessary for the development are situated within one hundred meters of any body of surface water (other than inclosed spring water); or within a ground water conservation area; or
3. The storage of water in, or the abstraction of water from, a dam constructed in any channel or depression which the Authority has declared, by notice published in the Gazette, not to constitute a watercourse for the purposes of the Act.

Permits may be applied for from WRA and in may be subject to EIA in accordance with the requirements of the EMCA of 1999, payment of a prescribed fee and completion of an application form. The WRA determines an application for a permit as soon as practicable after its lodgement but where an application duly made in accordance with the procedure is not determined by the Authority within six months after lodgement, any fee paid by the applicant will be refunded to the applicant. Every permit will be subject to subsequent variation by the Authority after hydro graphic survey of the relevant body of water has been made, and after reasonable notice has been given to all parties affected.

Licenses for provision of water are also a requirement and application for which is made to the water regulatory board and within the limits of supply of a licensee provide water services to more than twenty households; or supply more than twenty-five thousand litres of water a day for domestic purposes; or more than one hundred thousand litres of water a day for any purpose, except under the authority of a license. A licensee may, on any land belonging to him, or over or in which he has acquired any necessary easement or right, construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon such land or otherwise for preventing water belonging to the licensee, or which he is for time being authorized to take, from being polluted. This is Provided that before constructing any works the licensee, if the proposed works will affect or be likely to affect any body of water in the catchment in which the works are situated, will obtain the consent of the Authority.

The Authority may also where it finds it necessary, for public interest, to take special measures in area for the conservation of groundwater. The Act also establishes the national water services authority and the minister formulates who formulate the national water services strategy and publishes it in the Kenya gazette. The strategy seeks to institute arrangements to ensure that all times there is in every area of Kenya a person capable of providing water supply and to design a program to bring about progressive extension of sewerage to every center of population in Kenya.

Also in terms of acquisition of land A licensee, or an applicant for a license, who requires the compulsory acquisition of land for any of its purposes may apply to the Minister, who may, on the advice of the Regulatory Board, and upon being satisfied that such compulsory acquisition is desirable, take any steps necessary to secure the compulsory acquisition of the land in accordance with the Land Acquisition Act.

Thus the Kenya Water Act of 2002 will also provide guidelines and framework for the project's activities and through compliance the project will align its objectives with those of this act.

The main contractor will be required to implement necessary measures to ensure water conservation and also to prevent potential for water contamination during the construction phase to comply with this the developer will use a channel to direct water to the main channel just like the houses in the surrounding neighbourhood.

2.2.7 The Water Resources Management Rules, 2007

These rules guide all activities that are bound by the Kenya Water Act of 2002 and section 22 of the rules set categories for water use and those that require permits and they include water treatment works. Section 24 states that permit applications will be made by filling Form WRMA 001 and maps projected UTM based on the 1960 datum section 25 (1) & (2) and a site assessment and technical report is also a requisition under section 27.

Part IV of the rules apply to groundwater and section 72 (1) states that a permit is required by any person seeking to abstract groundwater. Part V also deals with water quality monitoring and effluent discharge and section 81 (1) states that no person will discharge or apply any poisonous, toxic, noxious or obstructing matter, radioactive waste or other pollutants or permit any person to dump or discharge such matter into any water resource unless the discharge of such poisonous, toxic, noxious or obstructing matter, radioactive waste or pollutant has been treated to permissible standards authorized by the Authority. Section 82 deals with affluent discharge to any water resource and sub-sections (a) –

(d) stipulate that no person will: discharge effluent into a water resource without a valid discharge permit issued by the Authority; discharge wastewater or effluent, which does not meet the water quality requirements stipulated in the effluent discharge permit; generate and discharge effluent onto land or into any water resource without compliance with an approved Effluent Discharge Control Plan; or discharge into any water resource effluent from a sewage treatment plant, trade or industrial facility without a calibrated flow measuring device approved by the Authority.

Conditions for water quality permits that guide the authority on the discharge/effluent are stated in section 83 and they include sub-section 1 the capacity of the receiving water resource to assimilate the effluent without violating the water resource quality objectives for that water resource, and sub-section 2 the toxicity and persistence of the pollutant(s).

Part IX of the regulations deal with conservation of riparian and catchment areas and riparian land on each side of watercourse is defined by section 116 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. Sub-section 4 adds that the riparian land will be measured from the top edge of the bank of the watercourse and this will also apply to seasonal and perennial watercourses. Section 118 (1) outlines activities that are not permitted on riparian land unless authorized by the Authority in consultation with other relevant stakeholders and the activities set out in the sixth schedule include:

- (a) Tillage or cultivation
- (b) Clearing of indigenous trees or vegetation
- (c) Building of permanent structures
- (d) Disposal of any form of waste within the riparian land
- (e) Excavation of soil or development of quarries
- (f) Planting of exotic species that may have adverse effect to the water resource
- (g) or any other activity that in the opinion of the Authority and other relevant stakeholders may degrade the water resource;

The proponent intends to exploit ground water resources. Other than conducting and Environmental Impact assessment for the said borehole, he shall ensure that the borehole is metered and that all licences and permits required by Water Resource Authority are obtained and properly maintained.

2.4. Occupational Safety and Health Act, 2007

Before any premises are occupied, or used a certificate of registration must be obtained from the chief inspector. The occupier must keep a general register. The Act covers provisions for health, safety and welfare of workers in any place of work.

2.4.1 Safety

Training and supervision of inexperienced workers should also be conducted. Floors, passages, gangways, stairs, and ladders must be soundly constructed and properly maintained and handrails must be provided for stairs.

Adequate and suitable means for extinguishing fire must be provided in addition to adequate means of escape in case of fire must be provided.

2.4.2 Health

The Housing Development must be kept clean, daily removal of waste from the Housing Development, free from effluvia arising from any drain, sanitary convenience or nuisance and without prejudice to the generality of foregoing provision.

The circulation of fresh air must secure adequate ventilation of guest rooms. There must be sufficient and suitable lighting in every part of the workplace in which persons are working or passing.

2.5. Environmental Management and Coordination Act No 8 of 1999.

This project report has been undertaken in accordance with the Environmental (Impact Assessment and Audit) regulation 2003, which operationalize the Environmental Management and Coordination Act 1999. The report is prepared in conformity with the requirements stipulated in the environmental management and coordination act no 8 of 1999 (EMCA) and the Environmental Impact Assessment and Audit Regulations 2003 regulation 7 (1) and the second schedule. Part II of the said act states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. In order to achieve the goal of a clean environment for all, new projects listed under the second schedule of Section 58 of EMCA no 8 of 1999 shall undergo an environmental Impact Assessment. This includes development activities such as this construction project.

*The decision by the **proponent**, to undertake an Environmental Impact Assessment study for the proposed development is in line with this provision. The proposed project falls under category of the projects listed in the second schedule of EMCA 1999.*

Part VII, Section 68 of the same Act requires operators of projects or undertakings to carry out environmental audits in order to determine level of conformance with statements made during the EIA. The audit report should be submitted to NEMA.

The Proponent will have to undertake an environmental audit for the development and prepare a related report for submission to NEMA in the first year of project operation to confirm the efficacy and adequacy of the Environmental Management Plan proposed in this EIA study report.

Part VIII, Section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. *Section 73* requires that operators of project which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. *Section 74* demands that all effluent generated from point sources are discharged only into the existing sewerage system upon issuance of prescribed permit from the local authorities. *Section 87 sub-Section 1* states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while *Section 88* provides for acquiring of a license for generation, transporting or operating waste disposal facility. *According to Section 89*, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste shall apply to the NEMA for a license. *Sections 90 through 100* outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides.

The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as air pollution control equipments, solid waste and effluent management plans, landscaping and aesthetic improvement programme are designed, constructed and employed simultaneously with the proposed project. This is evidenced in the attached project design.

This study report has been undertaken in accordance with the Environmental (Impact Assessment and Audit) regulation 2003, which operationalizes the Environment Management and Coordination Act, 1999.

▪ **Legal Notice No. 121: Section 4-6**

Part II of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 states that:-

4. (1) no person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle.
(2) a waste generator shall collect, segregate and dispose such waste in a manner provided for under these regulations
5. (1) a waste generator shall minimize the waste generated by adopting the following cleaner production methods
 - a) Improvement of production process through:-
 - i. Conserving raw materials and energy;
 - ii. Eliminating the use of toxic raw materials; and
 - iii. Reducing toxic emissions and wastes
 - b) Monitoring the production cycle from beginning to end by:-
 - i. Identifying and eliminating potential negative impacts of the product;
 - ii. Enabling the recovery and re-use of the product where possible;
 - iii. Reclamation and recycling
 - c) Incorporating environmental concerns in the design and disposal of a product.
6. A waste generator shall segregate waste by separating hazardous wastes from non-hazardous waste and shall dispose of such wastes in such facility as shall be provided by the relevant local authority.

▪ **Legal Notice No. 120; Part II – Protection of Sources of Water for Domestic Use.**

4. (1) every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution, and it shall be immaterial whether or not the water resource was polluted before the enactment of these Regulations
(2) no person shall throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution
5. All sources of water for domestic uses shall comply with the standards set out in the First Schedule of these Regulations.

As shown in the engineering design, there exists drainage systems and proper and the proponent proposes to install sufficient waste water management and handling system. The proponent also intends to develop proper waste water treatment facilities (BIOBOX Commercial Waste Water Management System) to ensure that the effluent attains the standards set out as described above. He shall also apply for an effluent discharge licence as the premises are not connected to a municipal sewerline. Regular effluent analysis shall be conducted to effectiveness of the treatment facility.

2.6. Public Health Act Cap 242 (Revised 1986)

Part IX section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health section 116 requires that local authorities take all lawful necessary and reasonable practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to injuries or dangerous to human health. Nuisances under this Act include any noxious matter or waste water, flowing or discharged from any premises wherever situated, into any public street, or into the gutter or side channel of any street or watercourse, or any accumulation or deposit of refuse or other offensive matter. Every council and every urban area council may make by-laws as to buildings and sanitation.

2.7. Physical Planning Act Cap 1999

This Act provides for the preparation and implementation of physical development plans for connected purposes. It establishes the responsibility for the physical planning at various levels of Government in order to remove uncertainty regarding the responsibility for regional planning.

It provides for a hierarchy of plans in which guidelines are laid down for the future physical development of areas referred to in specific plan. The ostensible intention is that the three-tier order plans, the national development plan, regional development plan, and the local physical development plan should concentrate on broad policy issues.

The Act also promotes public participation in the preparation of plans and requires that in preparation of plans, proper consideration be given to the potential for economic development, socio-economic development needs of the population, the existing planning and future transport needs, the physical factors which may influence orderly development in general and urbanization in particular, and the possible influence of future development upon natural environment. The innovation in the Act is the requirement for Environmental Impact

Assessment (EIA). Any change of use of the actual development without authority constitutes an offence.

2.8. The Electricity Power Act, 1997

Section 55 (1) in the execution of works in connection with the construction, modification, maintenance or operation of an electric supply line or apparatus or conductor connected thereto, every licensee shall:-

In no way injure the works, conveniences or property belonging to any such other such authority, company or person, nor obstruct or interfere with public traffic, except with the previous consent of the board. Take adequate precautions to protect from danger any person engaged upon such works by the provision and maintenance in safe and efficient conditions of the necessary safety appliances for the use of such persons and by ensuring their proper use, or by other means approved by the board.

2.9. The County Government Laws

The Project will operate within Machakos County and is thus under jurisdiction of the Matungulu Sub-County. The County operates by laws to govern all aspects of county management and is also at liberty to use the various pieces of legislation to enforce conservation and pollution control measures at the County. County government laws relevant to conservation, the general nuisance laws are quite pertinent. They include:

2.10.1. Deposit of Debris

Any person who shall without authority deposit or cause or permit to be deposited any soil, vegetation, refuse or debris or any land in the council shall be guilty of an offence.

2.10.2. Control of commercial development

A suitable site must be identified in the first instance the following conditions pertaining to suitable site must be complied with

- It must be a commercial zone or obtain a change of use
- It must be easily accessible
- It should be away from other industries dealing with offensive trades e.g. tanneries, hides and skins etc
- It must be near suitable solid waste disposal grounds/approved incinerators.
- It must be in an area easily supplied with water and power

2.10.3. Approval of Building Plans

After the site has been successfully identified, plans must be drawn and submitted for approval by the county government planning department. Amongst other requirements, the plan must have

- Proper drainage system
- An approved incinerator or legal waste disposal facility
- Proper sanitary facilities

- Adequate natural and artificial light and ventilation

2.10.4. Occupational Certificate

After the plans are approved and construction work completed the premises must be inspected by the County Government for the purpose of confirming whether the site complied with the approved plans then an occupation certificate issued as provided by the public Health Act and Building Code.

3. LOCATION AND DESIGN OF PROPOSED PROJECT

3.1 Project Location

The proposed project as earlier discussed, involves the construction of a mixed use development on Plot L. R. No. Donyo Sabuk/Komarock/ Block 1/ 89438.



Plate 3.1: Project Location

Longitudes: S1° 28' 3843"

Latitudes: E 37° 10' 1958"

Elevation: 361m (amsl)

The property is located about 500m to the East of Joska Centre off Nairobi-Kangundo Road towards Malaa. The proposed project lies in the neighborhood of a mixture of Residential and Commercial Developments. It is directly opposite Mogas Petrol Station, Joska.

3.2 Project Design

The building project involves the construction of two blocks of mixed commercial and residential units. The development is on 1 acre of land and shall be implemented in phases. Although the design of phase 2 block has not been developed, it shall be a mirror of phase one block in terms of form, height and skyline. Phase one comprises of one block of both commercial and residential units as follows:

- Ground Floor – 10,561 sqft commercial space and 13,455 sqft parking space
- 1st Floor – 10,571 sqft Commercial space
- 2nd Floor – 10,967 sqft commercial space
- 3rd Floor – 10,967 sqft commercial space
- Mezzanine Floor 1 to Mezzanine Floor 5 – 8 No. One Bedroom and 5 No. Two Bedroom Residential Units per floor. (Total 40 No. One Bedroom and 25 No. Two Bed Room Units).
- 4th Floor to 8th Floor – 15 No. One Bedroom and 10 No. Two Bedroom Residential Units per floor. (Total 75 No. One Bedroom and 50 No. Two Bedroom Units).

The buildings and amenities are typical in design, structure and details.

The design of the project has been executed with due consideration of the existing topography of the proposed project site. In general, the design of the project will optimize the use of the best available technology (BET) to prevent or minimize potentially significant environmental impacts associated with the project and to incorporate efficient operational controls together with trained staff, to ensure high level business and environmental performances.

3.3.1. Infrastructure

The development will have a comprehensive and robust infrastructure including access and exit to and from Kangundo Road, parking areas, water storage, electricity distribution and waste disposal mechanism.

3.3.2. Electrical system

There will be connection to the existing electricity main line of the Kenya Power and Lighting Company, which will be used in all phases of the project. The necessary

guidelines and precautionary measures relating to the use of electricity shall be adhered to.

3.3.3. Water Reticulation system

The water used at the site and its environs is obtained from a proposed project borehole. During the construction phase, water bowsers will be used to supplement water to the proposed site on need basis. However during the occupation phase and as construction work continues, the proponent will undertake ground water prospects, she shall therefore apply for a borehole drilling permit from WRA. An EIA of the same shall be conducted once the permit is issued. More over there will be water storage tanks to increase water supply to various components of the houses during the occupation phase. Underground water storage is recommended to store rain water harvested from the roof catchment.

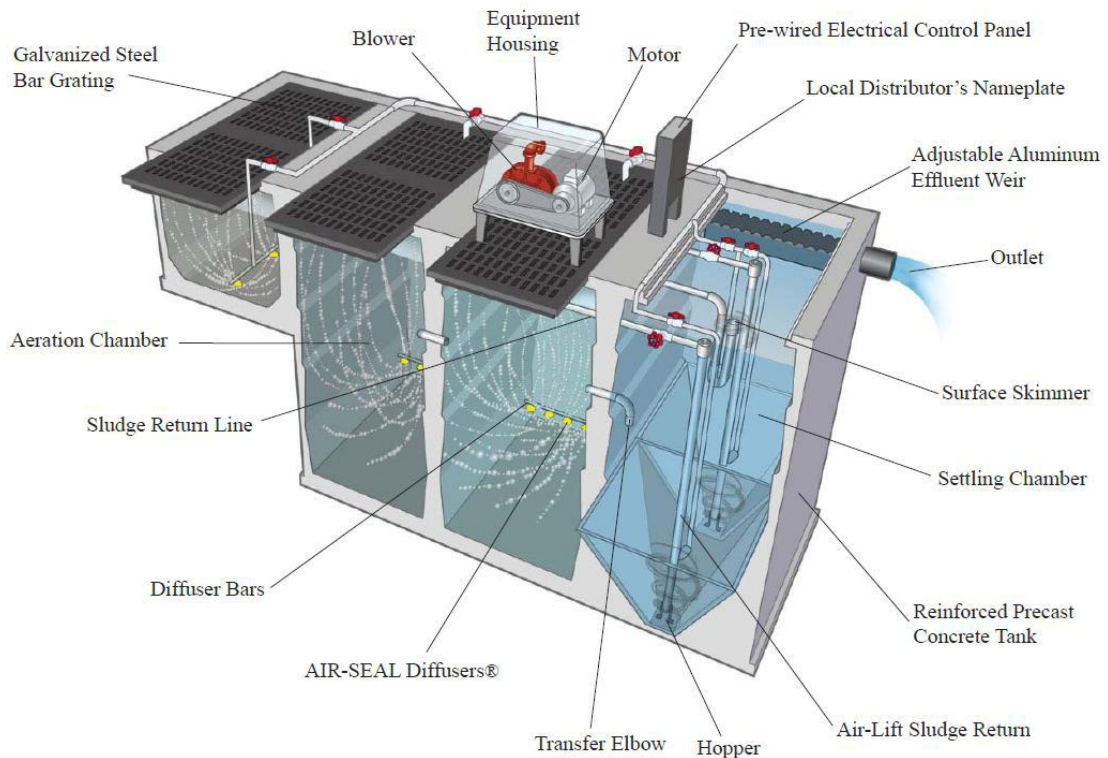
3.3.4. Sewerage & Solid Waste Management

The area is not covered by the municipal sewerline therefore the resultant development will be connected to a waste water treatment plant. The same will be desludged on a regular basis by licenced waste handlers and the resultant liquid waste water recycled through irrigation of the open areas such as the play area. The treatment plant will be made up of corrosion free, reinforced concrete tank for durability. All resultant treated water can be used for irrigation, construction works, flushing of toilets and recharging of water aquifers. As indicated elsewhere in the EIA report the proposed project requires water for irrigation and domestic use. The water requirement for the proposed project will be met from the abundantly available ground water resources.

3.3.4.1. Effluent treatment process

All effluent from the premises shall undergo treatment through a JET Commercial treatment plant shown in the photo below.

CUTAWAY OF TYPICAL JET COMMERCIAL PLANT



Jet Wastewater Treatment Plants employ a biological process known as “extended aeration” or “aerobic digestion.” In this process incoming wastewater enters an aeration tank where the contents are thoroughly mixed and aerated by large volumes of air which are pumped into the tank under pressure.

As the air bubbles to the surface, it transfers oxygen to the tank liquids. Aerobic bacteria present in the activated sludge in the tank use this oxygen to convert the wastewater to inoffensive, clear, odourless liquids and gases. Sometimes this process is referred to as “wet burning” because the bacteria actually destroy the wastewater by using oxygen, just as fire uses oxygen to burn trash. After the treated liquid leaves Jet’s Aeration Tank, it is held in a “settling” tank, which is completely still. Here any partially treated particles settle to the tank bottom and are returned to the aeration tank for further treatment. This settling produces a clear, highly treated liquid which is ready for final discharge.

Virtually all authorities agree that, except for municipal plants, extended aeration is the most efficient, complete method of wastewater treatment available today.

Solid waste management will consist of dustbins stored in cubicles protected from rain and animals. The waste will then be collected by a NEMA licensed private waste

management company and be composited, palletized or re-cycled depending on the waste management strategy to be adopted in line with the Environmental Management and Co-ordination (Waste Management) Regulations, 2006.

3.3.5. Security

The gate house will be located next to the main entrance for easy security operations around the compound a boundary wall connected with security alarms, entry control, and quick response systems will be used within the project area. Modern security systems including CCTV and electrical fences shall be installed.

3.3.6. Fire safety

The development provides for firefighting facilities such as fire extinguishers in the form of hydrants and carbon dioxide gas extinguishers.

3.3.7. Parking area

The drive way and parking area, which will be paved, will be spacious and provided with facilities such as lights, and signs for easy entry and exit to allow free flow of traffic.

3.3.8. Perimeter Fence

A stone perimeter wall will be erected around the project site.

3.3.9. Landscaping

The remaining open spaces will be landscaped after construction, using plant species available locally. This will include establishment of flower gardens and lush grass lawns to improve the visual quality of the site where pavements will not have taken space.

3.3.10. Buildings Construction

The technology used in the design and construction of the proposed project will be based on international standards, which have been customized by various commercial projects in Kenya.

The project will consist of the building with associated facilities, parking and infrastructure as presented in the architectural drawings in the appendix.

The building will be constructed as per the respective structural engineer's detail as provided for in the drawings presented in the Appendix. Basically, the building

structures will consist of concrete appropriately reinforced with metal (steel and iron). The roof will consist of structural timber and steel members and roofing tiles. The buildings will be provided with a well-designed concrete staircase for every block.

The buildings will be provided with facilities for drainage of storm water from the roof through peripheral drainage systems into the city council drainage system. Drainage pipes will be of the PVC type and will be laid under the buildings and the driveway encased in concrete.

The buildings will be connected to an Effluent Treatment Facility for discharge of sewage emanating from the project's operational activities.

The buildings will have adequate natural ventilation through provision of permanent vents in all habitable rooms, adequate natural and artificial light, piped water stored in above ground water tanks and firefighting facilities.

3.3 Project Site Description

The proposed project site neighbours similar such developments as earlier indicated. It is accessed using Kangundo Road and it is about 3km from Joska shopping centre. The proposed project site is currently undeveloped with only some show houses previously constructed but not completed.

The project site and its environs are situated within a zone that has similar residential houses.

3.4 Construction Materials and Technology

The building materials will consist of natural stones, sand, and cement. Also steel pipes, roofing tiles, wall tiles, PVC pipes, steel rods and glass will be used. Other materials that will be used on site include timber.

The building will be constructed as per the respective structural engineer's detail as provided for in the site plan. Basically, the building structure will consist of concrete appropriately reinforced with metal (steel and iron). The building will be provided with facilities for drainage of storm water from the roof through peripheral drainage

systems into the storm water drainage system. Drainage pipes will be of the PVC type and will be laid under the buildings and the driveway encased in concrete.

The buildings will have adequate natural ventilation through provision of permanent vents in all habitable rooms, adequate natural and artificial light, piped water stored in tanks and above ground water tanks provided with water pumps to feed overhead tanks.

The technology used in the design and the construction of the commercial building will be based on national and international standards which have been customized in Kenya. These include building standards including the Local Building Code and the British Building Standards BS 8110 and BS 5950, BS4449 and BS4461.

Important to note is that the constructions will incorporate;

- Environmental Protection and Resource Conservation guidelines
- Occupational Health and Safety measures.

4. DESCRIPTION OF THE PROJECT'S CONSTRUCTION ACTIVITIES

4.1 Pre-construction investigations

The implementation of the project's design and construction phase will start with thorough investigation of the site's biological and physical resources in order to minimize any unforeseen adverse impacts during the project cycle.

4.2 Sourcing and transportation of building materials

Building materials will be transported to the project site from the approved extraction, manufacture, or storage sites using transport trucks compliant with the traffic regulations. The building materials to be used in the construction of the project will be sourced from approved dealers. Greater emphasis will be laid on procurement of building materials from within the local area, which will make both economic and environmental sense as it will reduce negative impacts of transportation of the materials to the project site through reduced distance of travel by the materials transport vehicles.

4.3 Storage of materials

Building materials will be stored on site. Bulky materials such as rough stones/aggregate blocks, ballast, sand and steel will be carefully piled on site. To avoid piling large quantities on site, the proponent will order bulky materials such as sand, gravel and stones in bits. Materials such as cement, paints and glasses among others will be stored in the already completed rooms on the ground floor.

4.4 Excavation and Foundation Works

Excavation will be carried out to prepare the site for construction of the perimeter wall foundations, pavements and drainage systems. This will not involve the use of heavy earthmoving machinery such as tractors and bulldozers but manual excavation hence minimal dust.

4.5 Masonry, Concrete work and related activities

General masonry and related activities will include plastering and other finishing works on the building.

4.6 Roofing and sheet metal works

The construction of the building walls, foundation, floors, pavements, drainage systems and parking area among other components of the project will not involve a lot of masonry work and related activities. General masonry and related activities will include stone shaping, concrete mixing, plastering, and slab construction, construction of foundations and erections of building walls and curing of fresh concrete surfaces.

4.7 Electrical works

Electrical work during the construction of the premises will include installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets etc. in addition, there will be other activities involving the use of electricity such as welding and metal cutting.

4.8 Plumbing

Installation of pipe work for water supply and distribution will be carried out within the unit and associated facilities. In addition, pipe work will be done to connect drainage of storm water from the rooftop into the peripheral storm water drainage system. Plumbing activities will include metal and plastic cutting, the use of adhesives, metal grinding and wall drilling among others.

5. DECOMMISSIONING AND OPERATIONAL ACTIVITIES

5.1 Decommissioning Activities

5.1.1 *Dismantling of equipment and fixtures*

All equipment and fixtures including form wood will be dismantled and removed from the site on decommissioning of the project.

The contractor will ensure safe dismantling of the scaffolding, form wood used for reinforced concrete beams and columns, temporary store and site office.

5.1.2 *Removal of waste*

Waste from construction of the proposed housing development project will be carted away and disposed of at the Town council approved sites.

Waste found at the site will include

- The remainder of non re-usable construction materials from:
 - ⇒ Masonry works/building works, (cement bags, broken building blocks, etc.)
 - ⇒ Roofing (broken tiles, timber pieces, etc.)
 - ⇒ Painting, (paint cans, reject paints, masking tapes, etc.)
 - ⇒ Carpentry and joinery works (timber, nails, glue, etc.)
 - ⇒ Plumbing (pipe fittings and off cuts, etc.)
 - ⇒ Electrical works (residual cables and connectors, damaged electrical fittings, etc.)
- Wastes generated from dismantling of fixtures and construction equipments.
- Wastes generated from wrappers and packaging material

5.1.3 *Site restoration*

Once all the waste resulting from demolition and dismantling works is removed from the site, the open earth sites will be restored through replenishment of the topsoil and re-vegetation using indigenous plant species.

5.2 Operational activities

5.2.1 Solid waste generation on occupancy

Various activities such as use of sanitary facilities and occupation of the house will result in the production of a lot of solid waste including food wastes as well as papers.

5.2.2 Solid waste and waste water management

The proponent will provide facilities for handling solid waste generated within the facility. These will include dustbin, a central waste collection for temporarily holding waste within the premises before segregation and final collection for transportation.

Sewage generated from the building will be discharged into the Town Council Sewerage system, while storm water from the project area will be channeled into the storm water drainage system that exists into the councils' rain water system.

5.2.3 Cleaning

Proponent will employ people who will be responsible for regular washing and cleaning of the house. These people will be responsible for gathering and delivering waste onto the central collection place provided within the building. Cleaning operations will involve the use of substantial amounts of water, disinfectants and detergents.

5.2.4 General repairs and maintenance

The rooms and associated facilities will be repaired and maintained regularly during the occupational phase of the project. Such activities will include repair of building walls and floors, repair and maintenance of electrical fittings and equipment, repairs of leaking water pipes, painting and replacement of worn out materials among others.

6 BASELINE ENVIRONMENTAL AND SOCIAL ECONOMIC INFORMATION

The regional area of the project site lies is composed of residential and commercial urban establishments with several key neighborhoods such as Petrol Stations, hardware shops, supermarkets amongst others. Over the past years Nairobi has grown rapidly impacting on the neighbouring counties like Machakos and Kajiado to develop satellite towns such as Joska. However, the growth rate of new apartment's construction as well as infrastructure growth to cater for the ever growing population falls far below demand. There is need for rapid development of new housing blocks as well as infrastructure to accommodate the demands and influx of the working class and community into emerging new industries.

The population of Nairobi grew from 8,000 in 1901 to 118,579 in 1948 (Rakodi 1997). By 1962; the city had a population of 343,500 people, although some of this could be attributed to extension of the city's boundaries. Between the 1948 and 1962 censuses, the population grew at an average rate of 5 .9 per cent per annum, compared with 7 .6 per cent in the previous 12-year period. Taking the 1999 census figures as a baseline, it is projected that the city's population by the next census in 2009 will be about 3 .1 million, and 3 .8 million by 2015 (CBS 2001).

This chapter presents the baseline environmental, socioeconomic and cultural conditions of the project site and its environs. The scope of this chapter covers the project's area influence, the immediate neighbourhood around the project and then Nairobi County, across the subjects of:

- o Physical Environment,
- o Ecological Environment, and
- o Socio-cultural and Economic Environment.

6.1 Physical Environment

6.1.1 Climate

Machakos County is Semi-humid with about 400mm per annum of rainfall. The major monsoon season is experienced in the months of March, April and May, and is called the “Long Rains” by the locals. The minor monsoon seasons occur between October and December, referred as “Short Rains” period. It has high actual evapotranspiration rates of about 1000mm per annum.

The average daily temperatures in Nairobi varies only from about 17°C during July and August to 20°C in March, the daily range of temperature is quite large, averaging about 10°C in May and 15°C in February. These leads to Nairobi having an annual average temperature maximum of 24.9°C and an average minimum of 13.3°C and average mean relative humidity value is 78.3% in the morning and 50.5% in the afternoons.

Average Monthly rainfall (MM) for the last 50 years											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
49	49	115	195	137	42	15	21	24	52	114	77

That is the information derived from the meteorological department. With the climatic variations experienced globally, this climatic data has been changing over years

6.1.2 Winds

The wind near the ground is very predominantly easterly throughout the year, generally between north-east and east from October to April, and between east and south-east from May to September. The strongest winds occur during the dry season just prior to the "Long Rains" when speeds of 20 to 25 mph are common from mid-morning to early afternoon; at other times of the year winds speeds are usually 10 to 15 mph. During the night the wind is usually light. In the squalls sometimes associated with thunderstorms, short-lived of up to 70 mph. have been known to occur.

6.1.3 Soil and Geology

The site lies East of Ngong volcanic mass. Underlying the project area are the Upper Athi Series, Kapiti Phonolite and the Basement System of Rocks. The geology of the area comprises of Cenozoic Volcanics and sediments, the lavas showing an easterly flow direction away from the Rift Valley. The formations are deep and they rest directly on the Basement System Rocks. They are generally considered not older than Miocene.

The soils of the area are grey in colour, characteristic of volcanic areas. They owe their origin to weathering and erosion of the underlying volcanic rocks and may include clays, laterite and alluvial deposits.

Geotechnical investigations were carried out in the project site as part of its design phase and from trial pits black cotton soil was the predominant top soil discovered an average depth of 1.5 m from the surface then a small layer Murram which is found between an average depth gap of 3m to 5m then clays were observed.

6.1.4 Air Quality

The project area lies in the East of Nairobi, a satellite town in Machakos County which is generally an urban area, where the major sources of air pollution are as a result of industrial, construction, increased development activities and their related amenities (majorly cars). The situation is further compounded by the fact that air quality regulations are still being drafted leaving no regulations in place. These can be seen as the reason behind Nairobi having low air quality especially in the central business district and highly populated areas. An assessment by Maina D. (2004) found that Nairobi has higher levels of suspended particulate matter than WHO standards, with NO and NO₂ levels found being high during rush hour to show that vehicles are the main sources. Maina D. (2004) also found out that for fine particles there was a high correlation between the vehicles density and the fine particles. The high correlation between fine particles with Pb, Br, Zn and Cu is also associated with vehicular emissions as well as engine wear.

The situation with air pollutants could get worse with regulations taking long to come into place and the risks these pollutants (heavy metals and other waste gases) pose are to human health, flora, agro & wild faunal health and to soil quality as well as to water bodies. UNEP and WHO sampled air quality management capacities in 20 developing countries in 1996 and Nairobi was found to be the worst (as cited by Kariuki W. &

Mulaku C., 2001) due to the lack of air quality regulations. Kariuki W. & Mulaku C. stipulate that although the air quality does not present an environmental or critical health problem the situation could get worse with the increasing population, growing industrial area, deforestation on the city's fringes, increased construction works and increased vehicular traffic.

However the project area falls out of the central business and industrial districts thus enjoys better air quality and this forms part of the reason as to why the area is majorly residential. During the field survey the main sources of pollution (dusts and noise) that can be of concern was dust generated by trucks and cars moving in the area on the loose soil murrum roads (mobile sources), construction and the quarrying, which also uses light explosives. Other minor point sources are domestic activities will be generally contaminated by dust from the construction activities. However mitigation measures will be proposed to curb dust.

6.1.5 Noise Level

The existing noise level is normal but tends to rise with frequent movement of vehicles along the highway and the connecting roads.

6.2 Ecological Environment

6.2.1 Flora

The area is mostly covered by various buildings and very little if any open fields. There are no animals within this area of conservation value. 3.1.3 Flora

The project area lies generally in Nairobi/Machakos boundary which falls under several ecological zones which have biologically diverse floral species and the ecological zones confined within the boundary of the province include the zones II, III, IV and Mwaura (2005) adds that there is another ecological zone that occurs in Nairobi and this is the downtown flora which is the flora of urban areas.

This project area is predominantly ZONE IV. Zone IV as described by Mwaura (2005) has vegetation that includes dry woodland, bush land and grassland commonly referred to as savannah. The larger *Acacia gerrardii* is also found in few places. Other *Acacias* include *Acacia Senegal* and *Acacia seyal*. In areas where the soils are predominantly vertisols the grass community is dominated by *Cynodon*, *Sporobolus*,

Andropogon and Setaria while the star grass (*Themeda triandra*) and Zebra grass (*Hyparrhenia* spp.) are common in areas of latosolic soils.

Mwaura (2005) identifies the downtown flora as the flora of urban centres which includes a relatively high proportion of alien plant species. Some of the few indigenous trees in the city center include *Acokanthera oppositifolia*, *Acacia xanthophlea*, *Combretum molle*, *Cordia africana* and *Encephalartos hildebrandtii* although many of these have originated from up-country sources. The common shade and ornamental trees within the City of Nairobi include *Jacaranda mimosifolia* from Brazil, *Chorisia speciosa* (Brazil), *Aloe bainesii* (South Africa), *Bauhinia variegata* (Asia), *Brachychiton populneum*, *Grevillea robusta* (Australia), *Schinus molle* (Peru) and a wide range of local and foreign Acacias and Terminalias. Others include a wide range of ornamental palms like the *Caryota urens* (Asia) and the Arizona desert palm (*Washingtonia filifera*).

The area is also characterized by urban farming and indeed the land is currently under crops. Urban farming also promotes the cultivation of certain food crops in Nairobi and as observed by Foeken D. and Mwangi A. (1998) some of the crops cultivated in Nairobi include sukuma wiki (kale), tomatoes, beans, cowpeas, maize, Irish potatoes, sweet potatoes, arrowroot and bananas.

6.2.2. Fauna

Urban farming contributes to most of the faunal species in residential areas of Nairobi metropolis in terms of animals reared as livestock. Some of the animals reared in in the project areaa include poultry, goats, sheep, cattle, pigs and rabbits (Lee Smith et al, 1994). Most of the faunal species noted from the scoping survey were mainly as a result of urban farming and they included pigs, goats, chicken and cattle. There were some stray dogs spotted in the environs of the proposed project's site and some of the trees in the site also had bird nests as well as several bird species were spotted. The site also had some small invertebrates (lizards) and insects.

6.2.3. Ecological Sensitize Areas and Threatened/Rare/Endangered Species

The project site doesn't lie in any protected areas or ecologically sensitive areas and it is not a habitat or spawning ground for any threatened, rare or endangered species.

6.3 Social Economic Conditions

The main objective of this section is to present a comprehensive representation of the socio-economic characteristics of the project and the population it affects. The area is mainly resided by middle class of the Nairobi metropolitan populace.

Population is a major driver of environmental change in Nairobi and current trends point to the continued growth of Nairobi. This suggests a higher number of inhabitants with lifestyles that demand high energy, more land for the built environment, and increasing natural resources consumption. This has implications for the natural ecosystems that are crucial for maintaining ecological and ultimately economic stability. According to the 2009 Housing and Population Census, the average population density of Nairobi County is 4,509 people/km² but this figure varies significantly across the different divisions and constituencies.

During the field and socio-economic survey it was noted that the residents of the area make their livelihoods in a variety of ways in both in the formal and informal sector. Some people work as far as in the central business district where as others work in these sectors locally, through shops in the commercial and market centers, others work in the local institutions fulfilling diverse roles.

Some of the businesses in the area included; shops, banks, restaurants, apartments and letting businesses (real estate) just to mention a few. Others included the vast number of schools and educational institutions in the area that have employed locals. Some locals are also employed in the construction teams in the myriad sites and developments occurring in the area that were under construction during the field survey.

According to the Human Development Report 2005, 42%³ of the Kenyan population lives below the national income poverty line, while Nairobi was reported to have a poverty rate of 22%. The average income in Kenya is around Ksh100 (\$1.32) a day.

The socioeconomic diversities in the province greatly influence the quality of life of the people, and poverty reduces the access to resources that the people may use to improve their livelihoods. Poverty is one the main factors that influences the quality of health of people in Nairobi and Kenya in general since restricts the quality and access to health care that an individual can get. This therefore leaves the people vulnerable to endemic

diseases that occur as a result of coupling factors linked to quality/hygiene and state of their surroundings. Linked to their socioeconomic wellbeing and quality of housing it can be seen that fever, malaria and respiratory diseases are the most prevalent causes of morbidity in Nairobi, while most health facilities are concentrated around the urban areas of Nairobi in general.

The proposed project is in line with the governments' housing policy that aims to facilitate the attainment of adequate shelter and healthy living environment to all socioeconomic groups in Kenya. The project will therefore help to increase settlement in the region by investing in the construction industry; the proponent will also contribute towards the economic growth of our nation through revenue collection. In particular, the proposed project will generate the following positive socio-economic impacts:

1. The proponent will rent the residential development to the public. The proposed project will therefore serve as a source of income to the proponent thereby improving their living standards
2. During the operation phase of the project, the proponent will be required to pay tax to the government hence contributing to the economic growth of our nation
3. The proposed project will indirectly contribute towards enhancement of security in the neighbourhood of the area
4. The proposed project will generate revenue to the County through payment of connection and service fee.

Apart from the direct employment of construction workers, the proposed project will also benefit the following categories of individuals:

- Transporters. Investors on lorry and trailer transport will benefit greatly from the project. This benefit will extend to vehicle dealers and manufacturers, lorry drivers and turn boys.
- Cement Manufacturers. The local cement manufacturers and their employees and shareholders are direct beneficiaries of the development.
- The government will also get some impressive increase in V.A.T. and other taxes levied on cement.

- Manufacturers and dealers of other building materials. Most of the building materials to be used are locally manufactured. Relevant companies, their workers and shareholders will be direct beneficiaries of the development.
- Locals involved in sand harvesting are to be major beneficiaries' of the project. The benefit will extend to the local authority entitled to levy taxes on sand transporters.
- Ballast Quarries. There will be massive use of ballast. These will ensure that the Quarry owners and workers benefits greatly.

7. IMPACT ASSESSMENT METHOD

7.1 Site Visit Approach

Site visit to the proposed project area was concluded on 30th October, 2019. During these visits, a field tour of the general area was undertaken and detailed examination of the ecological settings of the area was noted. The environmental conditions existing in the proposed project area were documented to provide the baseline data. The possible impacts of the proposed project activities were assessed against the documented baseline data.

7.2 Public Consultation approach

7.2.1 *Consultation with Interested and Affected Parties*

The consultation process included to a large extent public consultation through dialogue with interested and affected parties.

The proponent also will place signs/bill boards on the site and on the roads near the site to communicate with the neighbours of the proposed project and anticipated impacts and mitigation measures.

7.2.2 *The Content of the Questionnaire*

- 1) Awareness about the proposed housing development project.
- 2) Whether the proposed housing development project will cause the negative impacts on the following.
 - (i) Local residents
 - (ii) Natural ecology of the area
 - (iii) The human environment
 - (iv) Recreational /leisure facilities
 - (v) Public health and safety
 - (vi) Effect on water resources and quality
 - (vii) The soil Quality in the local area
 - (viii) The areas of scenic beauty

- (ix) Road transport
- (x) Drainage of the area

7.2.3 *The results of the consultation*

The result of the consultation is that most of the respondents were made aware of the proposed Mixed Development and welcomed this development indeed as evidenced by the attached filled up questionnaires. We note that the proponent has chosen to comply with the Legal Notice No. 101 of June 2003 that requires all development projects to undertake an Environmental Impact Assessment exercise. The proponent undertook this exercise in order to address any negative impacts that may be arising from the project development. Most of the residents that we interviewed expressed their acceptance for the proposed mixed development.

7.2.4 *Observations and Data Collection*

The site reconnaissance focused on observation of the ecological status of the site, the vegetative cover, the soils and the landscape condition as well as other environmental conditions. The anticipated impacts are depicted during the planning, construction and decommissioning, and operation/occupation phases. High impacts are associated with severe consequences within a short term while medium impacts relate to consequences sustained over a long duration exposure. Low impacts imply that the environment can recover from the resulting consequences as soon as the exposure is terminated.

8. POTENTIAL IMPACTS AND MITIGATION MEASURES

8.1. Introduction

This chapter outlines the potential negative and positive impacts that will be associated with the mixed development development project. The impacts will be related to activities to be carried out during construction of the project. The operational phase impacts of the project will be associated with the activities carried out by the residents/tenants, which will mainly be domestic. In addition, closure and decommissioning phase impacts of the project are also highlighted.

The impacts of the mixed development development project during each its life cycle stages (construction, operation and decommissioning) can be categorized into: impacts on the biophysical environment; health and safety impacts; and socio-economic impacts.

8.2. Negative Environmental Impacts of Construction Activities

8.2.1.Extraction and Use of Building Materials

Building materials such as hard core, ballast, cement, rough stone and sand required for construction of the proposed project will be obtained from quarries, hardware shops and sand harvesters who extract such materials from natural resource banks such as rivers and land. Since substantial quantities of these materials will be required for construction of the buildings, the availability and sustainability of such resources at the extraction sites will be negatively affected, as they are not renewable in the short term. In addition, the sites from which the materials will be extracted may be significantly affected in several ways including landscape changes, displacement of animals and vegetation, poor visual quality and opening of depressions on the surface leading to several human and animal health impacts.

8.2.2.Dust Emissions

During construction, the project will generate substantial quantities of dust at the construction site and its surrounding. The sources of dust emissions will include site preparation and levelling works, and to a small extent, transport vehicles delivering building materials. Emission of large quantities of dust may lead to significant

impacts on construction workers and the local residents, which will be accentuated during dry weather conditions.

8.2.3. Traffic flow during construction

There is a likelihood of increase in traffic on road adjacent to the site during construction. The trucks used to transport various building materials from their sources to the project site will contribute to increases in emissions of dust, CO₂, NO_x and fine particulate along the way as a result of diesel combustion. Such emissions can lead to several environmental impacts including global warming and health impacts. Because large quantities of building materials are required, some of which are sourced far, such emissions can be enormous and may affect a wider geographical area. The impacts of such emissions can be greater in areas where the materials are sourced and at the construction site as a result of frequent running of vehicle engines, frequent vehicle turning and slow vehicle movement in the loading and offloading areas may slow down traffic flow.

8.2.4.Noise and Vibration

The construction works, delivery of building materials by heavy trucks and the use of machinery/equipment including bulldozers, generators, metal grinders and concrete mixers will contribute high levels of noise and vibration within the construction site and the surrounding area. Elevated noise levels within the site can affect project workers and the residents, passers-by and other persons in within the vicinity of the project site.

8.2.5.Risks of Accidents and Injuries to Workers

Because of the intensive engineering and construction activities including erection and fastening of roofing materials, metal grinding and cutting, concrete work, steel erection and welding among others, construction workers will be exposed to risks of accidents and injuries. Such injuries can result from accidental falls from high elevations, injuries from hand tools and construction equipment cuts from sharp edges of metal sheets and collapse of building sections among others.

8.2.6.Solid Waste Generation

Large quantities of solid waste (soil) will be generated as a result of excavation of the site. In addition, additional solid waste will be generated at the site during construction of the building and related infrastructure. Such waste will consist of metal cuttings, rejected materials, surplus materials, surplus oil, excavated materials, paper bags, empty cartons, empty paint and solvent containers, broken glass among others. Such solid waste materials can be injurious to the environment through blockage of drainage systems, choking of water bodies and negative impacts on human and animal health. This may be accentuated by the fact that some of the waste materials contain hazardous substances such as paints, cement, adhesives and cleaning solvents, while some of the waste materials including metal cuttings and plastic containers are not biodegradable and can have long-term and cumulative effects on the environment.

8.2.7.Energy Consumption

The project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil energy is non-renewable and its excessive use may have serious environmental implications on its availability, price and sustainability. The project will also use electricity supplied by Kenya Power & Lighting Company (KPLC) Ltd. Electricity in Kenya is generated mainly through natural resources, namely, water and geothermal resources. In this regard, there will be need to use electricity sparingly since high consumption of electricity negatively impacts on these natural resources and their sustainability.

8.2.8.Water Use

The construction activities will require large quantities of water that will out-sourced mainly through water bowsers. The proponent also proposes to sink a bore hole as an additional water source. A separate EIA should be done after acquiring a permit from WRMA. Water will mainly be used for concrete mixing, curing, sanitary and washing purposes. Excessive water use may negatively impact on the water source and its sustainability.

8.3. Positive Environmental Impacts of Construction Activities

8.3.1. Creation of Employment Opportunities

Several employment opportunities will be created for construction workers during the construction phase of the project. This will be a significant impact since unemployment is currently quite high in the country at large.

8.3.2. Provision of Market for Supply of Building Materials

The project will require supply of large quantities of building materials most, of which will be sourced locally. This provides ready market for building material suppliers such as quarrying companies, hardware shops and individuals with such materials.

8.3.3. Increased Business Opportunities

The large number of project staff required will provide ready market for various goods and services, leading to several business opportunities for small-scale traders such as food vendors around the construction site.

8.4. Negative Environmental Impacts of Operational Activities

8.4.1. Solid Waste Generation

The project is expected to generate enormous amounts of solid waste during its operation phase. The bulk of the solid waste generated during the operation of the project will consist of paper, plastic, glass, metal, textile and organic wastes. Such wastes can be injurious to the environment through blockage of drainage systems, choking of water bodies and negative impacts on animal health. Some of these waste materials especially the plastic/polythene are not biodegradable may cause long-term injurious effects to the environment. Even the biodegradable ones such as organic wastes may be injurious to the environment because as they decompose, they produce methane gas, a powerful greenhouse gas known to contribute to global warming.

8.4.2. Energy Consumption

During operation, the family units will use a lot of electrical energy mainly for domestic purposes including lighting, cooking, running of air conditioning equipment, running of refrigeration systems, pumping water into reservoirs. Since

electricity generation involves utilization of natural resources, excessive electricity consumption will strain the resources and negatively impact on their sustainability. The proponent as mentioned elsewhere in the report has contracted a green concept consultant to advice on green issues that include energy use and management.

8.4.3. Water Use

The domestic activities during the operation phase of the project will involve the use of large quantities of water.

8.4.4. Increased Population

Considering a medium family of 5 occupying one unit, the proposed project will house approximately 500 people. This is a significant increase in local population.

8.4.5. Increased Traffic

If every household has one car, there shall be an increase in traffic of approximately 100 motor vehicles. These shall have negative impacts to the environment through increased emissions and fuel consumption.

8.5. Positive Environmental Impacts of Operational Activities

8.5.1. Provision of Mixed development

The project will provide affordable modern buildings with new and state of the art infrastructure to residents. This impact will be significant since Nairobi is currently experiencing a shortage of such facilities.

8.5.2. Employment Opportunities

Some people will be employed by the project as management agents, caretakers, cleaners, security personnel and technicians.

8.5.3. Revenue to National and County Governments

Through payment of relevant taxes, rates and fees to the government and county government, the proposed project will contribute towards the national and county revenue earnings.

8.5.4.Improved Security

Security will be ensured around the development through distribution of suitable security lights and presence of 24-hour security guards. This will lead to improvement in the general security in the surrounding area.

8.6. Negative Environmental Impacts of Decommissioning Activities

8.6.1.Solid Waste

Demolition of the project small buildings and related infrastructure will result in large quantities of solid waste. The waste will contain the materials used in construction including concrete, metal, drywall, wood, glass, paints, adhesives, sealants and fasteners. 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. In addition, even the generally non-toxic chemicals such as chloride, sodium, sulphate and ammonia, which may be released as a result of leaching of demolition waste, are known to lead to degradation of groundwater quality.

8.6.2.Noise and Vibration

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

8.7. Positive Environmental Impacts of Decommissioning Activities

8.7.1.Rehabilitation

Upon decommissioning the project, rehabilitation of the project site will be carried out to restore the site to acceptable status. This will include replacement of topsoil and re-vegetation that will lead to improved visual quality of the area.

8.7.2.Employment Opportunities

Several employment opportunities will be created for demolition staff.

9. IMPACTS MITIGATION AND MONITORING

9.1. Introduction

This chapter highlights the necessary mitigation measures that will be adopted to prevent or minimize significant negative environmental, health and safety impacts associated with the activities the project during its construction, operation and decommissioning phases. Allocation of responsibilities, time frame and estimated costs for implementation of these measures are presented in the environmental management programme (EMP) in Chapter 8.

9.2. Mitigation of Construction Phase Impacts

9.2.1. Efficient sourcing and Use of Raw Materials

The proponent will source building materials such as sand, ballast and hard core from registered quarry and sand mining firms, whose projects have undergone satisfactory environmental impact assessment/audit and received NEMA approval. Since such firms are expected to apply acceptable environmental performance standards, the negative impacts of their activities at the extraction sites are considerably well mitigated.

To reduce the negative impacts on availability and sustainability of the materials, the proponent will only order for what will be required through accurate budgeting and estimation of actual construction requirements. This will ensure that materials are not extracted or purchased in excessive quantities. Moreover, the proponent will ensure that wastage, damage or loss (through run-off, wind, etc) of materials at the construction site is kept minimal, as these would lead to additional demand for and extraction or purchase materials.

In addition to the above measures, the proponent shall consider reuse of building materials and use of recycled building materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites.

9.2.2. Minimization of Run-off

The proponent will put in place some measures aimed at minimizing soil erosion and associated sediment release from the project site. These measures will include

terracing and levelling the project site to reduce run-off velocity and increase infiltration of rainwater into the soil. In addition, construction vehicles will be restricted to designated areas to avoid soil compaction within the project site, while any compacted areas will be ripped to reduce run-off.

9.2.3. Minimization of Construction Waste

It is recommended that demolition and construction waste be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses. In this regard, the proponent is committed to ensuring that construction materials left over at the end of construction will be used in other projects rather than being disposed of. In addition, damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects. Such measures will involve the sale or donation of such recyclable/reusable materials to construction companies, local community groups, institutions and individual residents or homeowners.

The proponent shall put in place measures to ensure that construction materials requirements are carefully budgeted and to ensure that the amount of construction materials left on site after construction is kept minimal.

It is further recommended that the proponent should consider the use of recycled or refurbished construction materials. Purchasing and using once-used or recovered construction materials will lead to financial savings and reduction of the amount of construction debris disposed of as waste.

Additional recommendations for minimization of solid waste during construction of the project include:-

- i. Use of durable, long- lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time
- ii. Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements

- iii. Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials
- iv. Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste
- v. Use of construction materials containing recycled content when possible and in accordance with accepted standards.

9.2.4. Reduction of Dust Generation and Emission

Dust emission during construction will be minimized through strict enforcement of onsite speed controls as well as limiting unnecessary traffic within the project site. In addition, it is recommended that excavation works be carried out in wet weather; and traffic routes on site be sprinkled with water regularly to reduce amount of dust generated by the construction trucks.

9.2.5. Minimization of impacts on traffic flow

The proponent will put in place measures to address such concerns by ensuring that construction vehicles preferably deliver materials during off-peak hours when traffic volume is low. There will also be provision for caution signs on the access road to alert users on construction activities in progress in order to prevent occurrence of accidents.

This will be achieved through proper planning of transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road. In addition truck drivers will be sensitized to avoid unnecessary racing of vehicle engines at loading/offloading areas, and to switch off or keep vehicle engines at these points.

9.2.6. Minimization of Noise and Vibration

Noise and vibration will be minimized in the project site and surrounding areas through sensitization of construction truck drivers to switch off vehicle engines while offloading materials. In addition, they will be instructed to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as churches, schools and hospitals. In addition, construction machinery shall be kept in good condition to reduce noise generation. It is recommended that all generators

and heavy-duty equipment be insulated or placed in enclosures to minimize ambient noise levels.

9.2.7. Health and safety of Workers on site

The proponent is committed to adherence to the occupational health and safety rules and regulations stipulated in Occupational Safety and Health Act, 2007. In this regard, the proponent is committed to provision of appropriate personal protective equipment such as gloves; helmets, overall as well as ensuring a safe and healthy environment for construction workers by providing sanitary facilities (toilets) and portable water while food will be bought by workers from the nearby hotels.

9.2.8. Reduction of Energy Consumption

The proponent shall ensure responsible electricity use at the construction site through sensitization of staff to conserve electricity by switching off electrical equipment or appliances when they are not being used.

In addition, proper planning of transportation of materials will ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts. Complementary to these measures, the proponent shall monitor energy use during construction and set targets for reduction of energy use.

9.2.9. Minimization of Water Use

The proponent shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water usage.

9.3. Mitigation of Operation Phase Impacts

9.3.1. Ensuring Efficient Solid Waste Management

The proponent will be responsible for efficient management of solid waste generated by the project during its operation. In this regard, the proponent will provide waste handling facilities such as waste bins and skips for temporarily holding domestic waste generated at specific places. In addition, the proponent will ensure that such disposed of regularly and appropriately. It is recommended that the proponent put in place measures to ensure that each facility manage their waste efficiently through recycling, reuse and proper disposal procedures.

9.3.2. Minimization of Sewage Release

The proponent will ensure that there are adequate means for handling the large quantities of sewage generated by the buildings being directed to the proposed effluent treatment plant.

9.3.3. Ensure Efficient Energy Consumption

The proponent plans to install an energy-efficient lighting system for the project. This will contribute immensely to energy saving during the operational phase of the project. In addition, occupants of the Houses will be sensitized to ensure energy efficiency in their domestic operations. To complement these measures, it will be important to monitor energy use during the occupation of the Houses and set targets for efficient energy use.

9.3.4. Ensure Efficient Water Use

The proponent will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff. In addition, the occupants of the Houses will be sensitized to use water efficiently.

9.4. Mitigation of Decommissioning Phase Impacts

9.4.1. Efficient Solid Waste Management

Solid waste resulting from demolition or dismantling works will be managed as described in Section 9.2.3.

9.4.2. Reduction of Dust Concentration

High levels of dust concentration resulting from demolition or dismantling works will be minimized as described in Section 9.2.4.

9.4.3. Minimization of Noise and Vibration

Significant impacts on the acoustic environment will be mitigated as described in Section 9.2.6.

9.5. Occupational Health and Safety Management

9.5.1.Introduction

Neema Trust Company Limited needs to recognize that some activities of any premises, organization or an individual leave an impact on the environment. In this respect, there is need to focus on reducing the environmental, health and safety impact of a number of activities through a programme of continuous improvement.

In this respect their environmental policy should focus on the following:-

- Quantify and monitor all environmental impacts of the project including any other new projects, and set specific targets;
- Comply with current legislations and, where practical, seek to meet future legislative requirements ahead of relevant deadlines;
- Integrate environmental, health and safety objectives into relevant business decisions in a cost-efficient manner;
- Require all employees to address environment, health and safety responsibilities within the framework of normal operating procedures;
- Minimize waste, seek to recover as much as is economically practical and ensure the remainder is disposed of responsibly;
- Maintain the appropriate emergency response plans for major incidents in order to minimize their environmental and safety impact;
- Influence suppliers of services and own-brand goods to reduce their impact on the environment;
- Enhance awareness of relevant issues among employees, clients, guests, colleagues and others who have an interest in the business;
- Document information on EHS performance.

9.5.2.Health and Safety Concerns during Construction Phase

During the construction phase, there will be increased dust, air and noise pollution; as well as accidents. These are considered as negative impacts as they significantly lower the quality of environment. The neighbours and workforce

involved would be more subjected to these environmental hazards and disturbances.

Mitigation

- Depending on the occupational safety and health hazards anticipated while performing assigned job tasks, workers may require using properly fitting personal protective equipment (PPE) to avoid injuries and illness. They (workers) must be provided with full protective gear. These include working boots, overalls, helmets, goggles, earmuffs, dust masks, gloves etc
- A First Aid Kit should be provided within the site and during construction phase. This should be fully equipped at all times and should be managed by qualified persons.
- Safety awareness may be gained through regular safety meetings, safety training or personal interest in safety and health. This awareness will increase ability to respond if, some day in future, one is a bystander in an emergency.
- The contractor should have workmen's compensation cover. It should comply with Workmen's Insurance Benefit Act (WIBA), 2007, as well as other ordinances, Regulations and union Agreements.
- Sanitary facilities should be provided and maintain Standard cleanliness of the facilities in line with the Occupational Safety and Health Act,2007 and the Public Health Act.
- Local individuals preparing food for the workers at the site must be controlled to ensure that food is hygienically prepared.
- Workers should always be sensitized on social issues such as drugs, alcohol, diseases etc. There should be training programs to facilitate this.
- Proper waste management of domestic waste to prevent vectoral diseases.
- Ensure consistently good water quality through regular water analysis to ascertain compliance to public health standards. This should be extended to the water harvested from the roof catchments.

Table 9.1. A Summary of Project Activities, Potential Impacts, and Proposed Mitigation Measures

PHASES	ACTIVITIES	POTENTIAL IMPACTS	RATING	MITIGATION MEASURES
Construction Phase	<ul style="list-style-type: none"> • Transportation of materials:- <ul style="list-style-type: none"> » Cement, Aggregates » Sand » Equipment » Labourers 	<ul style="list-style-type: none"> ➤ Possibility of oil spillage, spillage of materials, noise, dust pollution, soil contamination 	High	<ul style="list-style-type: none"> ✓ Ensure use of serviceable vehicles and equipment ✓ Contractor to ensure NO spillage occurs ✓ Take short period to implement project ✓ Also indicate along the road the direction where heavy vehicles are likely to be found
	<ul style="list-style-type: none"> • Storage of building materials 	<ul style="list-style-type: none"> ➤ Destruction of soil structure 	medium	<ul style="list-style-type: none"> ✓ Ensure use of manual labour and hand tools where appropriate ✓ Ensure building materials are stored properly ✓ Ensure labour regulations are adhered to strictly
	<ul style="list-style-type: none"> • Human activity at the construction site 	<ul style="list-style-type: none"> ➤ Solid waste generation by workers ➤ Possibility of accidents during construction 	High	<ul style="list-style-type: none"> ✓ Ensure effective collection of litter generated at the site ✓ Ensure strict adherence to occupational health and safety rules

Decommissioning Phase	<ul style="list-style-type: none"> • Demolition • Transportation • Disposal 	<ul style="list-style-type: none"> ➤ Possibility of oil spillage ➤ Noise and dust pollution ➤ Possibility of materials spillage 	Low	<ul style="list-style-type: none"> ✓ Ensure use of serviceable vehicles ✓ Ensure use of manual labour and hand tools ✓ Ensure proper storage of unused materials ✓ Ensure removal of all the materials brought in during construction
Operation phase (Occupancy)	<ul style="list-style-type: none"> • Maintenance of the building and the compound • Possibility of fire outbreaks • Increased waste and effluent production • Increased resource use (water & electricity) 	<ul style="list-style-type: none"> ➤ Improvements of associated facilities for the occupants ➤ Socio-economic benefit to the people through employment, a more vibrant economy ➤ Increased business due to the increase in population ➤ Proper housing for a high population in line with Vision 2030 	Low Impacts	<ul style="list-style-type: none"> ✓ Ensure proper waste management programme ✓ Ensure proper safety signage is placed at the site e.g. ‘No Smoking’, ‘Fire Exits’, ‘Emergency Switches’ etc. ✓ Ensure treatment for adequate effluent discharges and solid waste collection system is in place ✓ Install low flush toilets ✓ Install energy saving bulbs ✓ Ensure leaks are detected and repaired quickly

10. ALTERNATIVES INCLUDING THE PROPOSED ACTION

10.1. The proposed Development Alternative

The EIA Project report will be presented to the National Environmental Management Authority. This will help in evaluating and examining the effects of the project on the environment. After the evaluation and under the proposed development alternative, an *Environmental Impact Assessment (EIA) License* would be issued. This way, NEMA would approve for the implementation of the project. However, the development has to ensure that all environmental measures are complied with during the construction period and during occupation and operation.

The alternative consists of the proponent's/applicant's final proposal with the inclusion of the NEMA guidelines and regulations and procedures. This is as stipulated in the Environmental Management and Co-ordination Act (EMCA) of 1999, which aims at reducing environmental impacts to the maximum extent practicable.

10.2. Relocation alternative

Relocation option to a different site is an option available for the project implementation. At the moment, there are no alternative sites for the proposed development (i.e. the project proponent do not have an alternative site). The proponent has to look for the land if relocation is proposed. Looking for the land to accommodate the scale and size of the project and completing official transaction on it may take a long period. In addition, it is not guarantee that such land would be available.

The project proponent would spend another long period of time on design and approvals of the plans by the relevant departments. The Project design and planning before the stage of implementation would call for extra cost; already encountered in the proposed development i.e. whatever has been done and paid to date would be counted as a loss to the proponent. Assuming the project will be given a positive response (after (say) relocation) by the relevant authorities including NEMA, it (project) would have been delayed for a long period before implementation. This would also lead to a situation like No action Alternative (as explained below). The other consequence of this is that it would discourage both foreign and local investors especially in the building sector. In consideration of the above concerns and assessment of the current proposed site, relocation of the project is not a viable option.

10.3. The No Action Alternative

The No Action Alternative in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. However, the project process is also started and the anticipated insignificant environmental impacts resulting from construction have already been experienced.

This option will however, involve several losses both to the project proponent/land owner and the Kenyan society and Government. The property will remain under-utilized. The No Project Option is the least preferred from the socio-economic and partly environmental perspectives since if the project is not done:

- The economic benefits especially during construction i.e. provision of jobs for skilled and non-skilled workers will not be realized
- There will be no generation of income by the developer and the government.
- The government's development policy may not be realized
- The socio-economic status of Kenyans and the local people would remain unchanged.
- The local skills would remain under utilized
- No employment opportunities will be created for Kenyans who will work in the project area.
- Discouragement for investors to produce this level of standard and affordable developments.

From the analysis above, it becomes apparent that the No Project Alternative is not the appropriate alternative to the local people, Kenyans, and the government of Kenya.

10.4. The comparison of Alternatives

Under the proposed Development Alternative, the project would create more and standard commercial infrastructure, provide business outlets and would provide employment directly and indirectly to the Kenyan population. It would provide jobs for the workers during construction. After completion more jobs would be generated by the businesses within the project. Under the No Action Alternative, there would be

no development at all. There would be no benefits from the site and neither would there be the insignificant environmental Impacts.

Provided the Environmental Impact mitigation measures are implemented as well as adoption of sound construction management practices, negative effects on water, soil, air, sound, sewerage and drainage systems will be avoided /minimized. However, commitments related to development alternative would ensure that potential impacts are minimized to levels of insignificance.

10.5. Mitigation for the proposed Action

Mitigation measures include proper handling of the waste material as generated especially during clearing and preparation of the site. The application or adaptation of standard construction management practices is fundamental. Conflicts arising from the foreseen negative impacts will be solved through consultation with the neighbours/public; by explaining the mitigation measures prescribed for the impacts. In addition, the mitigation measures would be appropriately designed and implemented to protect the environment and especially water, soil, drainage, flora and fauna of the area/site. The environmental statutory certificate that would be issued and the project (environmental) aspects included in the report would help to control damage to the environment. This is in accordance to the Environmental Management and Co-ordination Act (EMCA), 1999.

11. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

The Environmental Management and Monitoring Plan (EMMP) allow measures to be implemented that will avert/prevent/mitigate negative impacts. The project site manager must ensure that the contractor implements all the proposed mitigation measures and in time and the contractual agreement should take account of the proposed EMMP inter-alia.

Simple monitoring tools will involve a checklist to record information relating to oil spills, leaks, liquid and solid wastes, noise levels and air pollution.

The prevalence of accidents in work place will require close monitoring.

The EMMP in the table below shows the impacts, mitigation measures, and implementation period, the required resources and the responsible persons to take the action.

Table 11.1. Environmental Management and Monitoring Plan (EMMP)

PROJECT DESIGN & CONSTRUCTION	PROJECT ACTIVITIES	NEGATIVE IMPACTS	MITIGATION MEASURES	RESPONSIBLE PERSONS	MONITORING MEANS	ESTIMATED COST (KSHS)
PRE-CONSTRUCTION PHASE	<ul style="list-style-type: none"> ➤ Consultation proposal ➤ Development proposal ➤ write-up 	✓ None	» None	Consultant/ proponent	Observation	Done
	<ul style="list-style-type: none"> ➤ Architectural drawings & specifications approval 	✓ None	» None	Architect/proponent	Observation	Done
	<ul style="list-style-type: none"> ➤ Structural Drawings & specifications approval 	✓ None	» None	Structural Engineer/proponent	Observation	Done
	<ul style="list-style-type: none"> ➤ Mechanical Drawings & specifications approval 	✓ None	» None	Mech. Engineer/proponent	Observation	Done
	<ul style="list-style-type: none"> ➤ Electrical Drawings & specifications approval 	✓ None	» None	Electrical Engineer/proponent	Observation	Done
	<ul style="list-style-type: none"> ➤ Site visit, ➤ Project Report formulation and write-up 	✓ None	» None	Environmental expert/proponent	Observation	Done
	<ul style="list-style-type: none"> ➤ Bill of quantities 	✓ None	» None	Quantity surveyor/proponent	Observation	Done

CONSTRUCTION PHASE	<ul style="list-style-type: none"> ➤ Superstructure construction 	<ul style="list-style-type: none"> ✓ Oil spillage ✓ Noise ✓ Dust ✓ Soil destruction 	<ul style="list-style-type: none"> » Ensure NO oil spillage occurs » Ensure use of manual labour and hand tools » Ensure use of serviceable machinery 	Contractor Supervising/Environmental expert	Inspection/ Observation	1,200,000 (Covered under planning and administration costs of the contractor)
	<ul style="list-style-type: none"> ➤ Construction of infrastructure utilities 	<ul style="list-style-type: none"> ✓ Oil spillage ✓ Noise ✓ Dust ✓ Soil destruction 	<ul style="list-style-type: none"> » Ensure NO oil spillage occurs » Ensure use of manual labour and hand tools 	Contractor Supervising/Environmental expert	Inspection/ Observation	1,800,000 (Covered under planning and administration costs of the contractor)
	<ul style="list-style-type: none"> ➤ Construction of facilities for solid waste handling and temporary storage 	<ul style="list-style-type: none"> ✓ Poor sanitation and environmental health degradation as a result of inadequate effluent waste water disposal and solid waste management 	<ul style="list-style-type: none"> » Ensure proper/sound waste bins provided » Ensure use of manual labour and hand tools » Ensure waste site 	Contractor Supervising/Environmental expert	Inspection/ Observation	1,500,000 (Covered under planning and administration costs of the contractor)

			covered on top			
	<ul style="list-style-type: none"> ➤ Construction of sewer pipes and run off drains 	<ul style="list-style-type: none"> ✓ Open pits ✓ Noise ✓ Dust ✓ Soil destruction ✓ Ground water pollution 	<ul style="list-style-type: none"> » Ensure no seepage of sewage to soil » Cover open pits during excavations 	Contractor Supervising/Environmental expert	Inspection/ Observation	4,200,000 (Covered under planning and administration costs of the contractor)
DE-COMMISSIONING PHASE	<ul style="list-style-type: none"> ➤ Site closure and Demolition of the site office 	<ul style="list-style-type: none"> ✓ Oil spillage ✓ Noise ✓ Dust ✓ Soil destruction 	<ul style="list-style-type: none"> » Ensure NO oil spillage occurs » Ensure use of serviceable machinery 	Contractor Supervising/Environmental expert	Inspection/ Observation	6,000,000 (Covered under planning and administration costs of the contractor)
OPERATIONAL PHASE/ OCCUPATION OF THE HOUSING DEVELOPMENT	<ul style="list-style-type: none"> ➤ General maintenance of the residential blocks of flats 	<ul style="list-style-type: none"> ✓ Oil Spillage ✓ Noise ✓ Generation of waste materials, e.g paints, painting accessories, e.t.c. 	<ul style="list-style-type: none"> » Develop and implement plans for maintenance of all site facilities » Establish environmental record keeping system. 	Proponent	Routine Inspection	Per Year: Kshs. 12,000,000 (Covered under planning and administration costs)

OPERATIONAL PHASE/ OCCUPATION OF THE HOUSING DEVELOPMENT	<p>➤ Generation of solid waste</p>	<p>✓ If not properly managed, could create hazardous condition</p>	<p>» Ensure solid waste is collected regularly by professional waste handlers and disposed off at the designated Town Council dumping sites.</p>	<p>Proponent</p>	<p>Routine Inspection</p>	<p>Per Year: Kshs. 1,600,000/=(Covered under planning and administration costs)</p>
	<p>➤ Generation of sewerage, waste water</p>	<p>✓ If not properly managed, could compromise sanitary hygiene of the Housing Development</p>	<p>» Ensure the sewage waste water is collected and disposed off into the treatment facility system ensuring no leakage to soil</p>	<p>Proponent</p>	<p>Routine Inspection</p>	<p>Per Year: Kshs. 3,000,000 (Covered under planning and administration costs of the proponent)</p>
	<p>➤ Storm water discharge into the storm water holding tank</p>	<p>✓ If not well directed to the main storm drain, could lead to flooding and property destruction</p>	<p>» Ensure the storm drain channels are regularly cleaned to remove debris</p>	<p>Proponent</p>	<p>Routine Inspection</p>	<p>Per Year: Kshs. 1,500,000 (Covered under planning and administration costs)</p>

OPERATIONAL PHASE/ OCCUPATION OF THE HOUSING DEVELOPMENT	▶ Significant energy and water consumption	✓ Could cause strain on the national grid and the town council water supply system	» Develop and maintain plans for energy and water conservation such as fitting of energy save bulbs, and level control water reticulation tanks	Proponent/Property Manager	Routine Inspection	Per Year: Kshs. 3,000,000 (Covered under planning and administration costs of the property Manager)
	▶ Environmental audit	✓ Non Compliance with the EMCA 1999 could result in closure of the facility	» Undertake an environmental audit of the project upon completion in compliance with the environmental management and coordination Act 1999.	Proponent	Routine Inspection	Per Year: Kshs. 500,000 (Covered under planning and administration costs)

	▶ Environmental education and awareness	✓ Lack of knowledge may result in disregard of the benefits attached to sustainable environmental management	» Awareness campaign for the inhabitants regarding resource conservation and environmental protection	Proponent	Observation	Per Year: Kshs. 400,000/= (Covered under planning and administration costs)
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12. PROJECT BUDGET

The project cost is estimated to be **Ksh 150,000,000 for every block. The total cost of the 2 Blocks comes to 300,000,000.** Licence fees applicable and payable to NEMA have been deduced from the same but the authority has since waived all the fees payable.

13. CONCLUSION AND RECOMMENDATION

13.1. Conclusion

The result of this EIA report has indicated that there are no significant and permanent negative impacts likely to be generated by the activities of the proposed project.

Most of the potential negative impacts to be generated have been as low and those rated as high can only cause irreparable damage to the environment and human health if the mitigation measures are not implemented as recommended.

It is therefore concluded that the proposed project will not compromise the well being of the environmental condition in the area.

13.2. Recommendations

Recommendations have been made in detail for the proposed mixed development project. These are summarized below:

- Workmen should be provided with suitable protective gear (such as nose masks, ear plugs/muffs, helmets, overalls, gloves, industrial boots, etc.), and there should be a fully equipped first aid kit on site.
- Adequate sanitary care facilities should be provided to the construction workers.
- Construction workers to be hired before hand and all measures to be taken to avoid prospective workers gathering at the gate waiting to be hired.
- The consultants and contractors are requested to ensure that the works are carried out in a proper manner and planning so as to minimize the negative impact of the construction in terms of noise.
- The consultants and contractors are requested to ensure that the works are carried out in a proper manner so as to minimize soil erosion, the impact of the construction on the air quality, and keep the site as tidy as possible. Construction debris should be cleared as and when specified tasks are completed.
- Any stockpiles of earth should be enclosed, covered or watered during dry or windy conditions to reduce dust emissions.
- All drainage structures must ensure the safe final disposal of water and must also be self-cleaning. During construction, the design must ensure that flow of water in the storm water drains is not impeded.

- Proponent to liaise with NEMA licenced waste handlers to handle waste collection/disposal during the construction and operation phases of the housing development.
- Once earthworks have been done, restoration of the worked area should be carried out immediately, by backfilling, and planting of grass or shrubs. Landscaping of the site will provide habitats to other small animals and bird life.
- Where possible, recyclable items should be collected for re-use.
- Warning/informative signs should be erected when construction works are about to begin. Signs should indicate when works are likely to begin and end.

APPENDIX