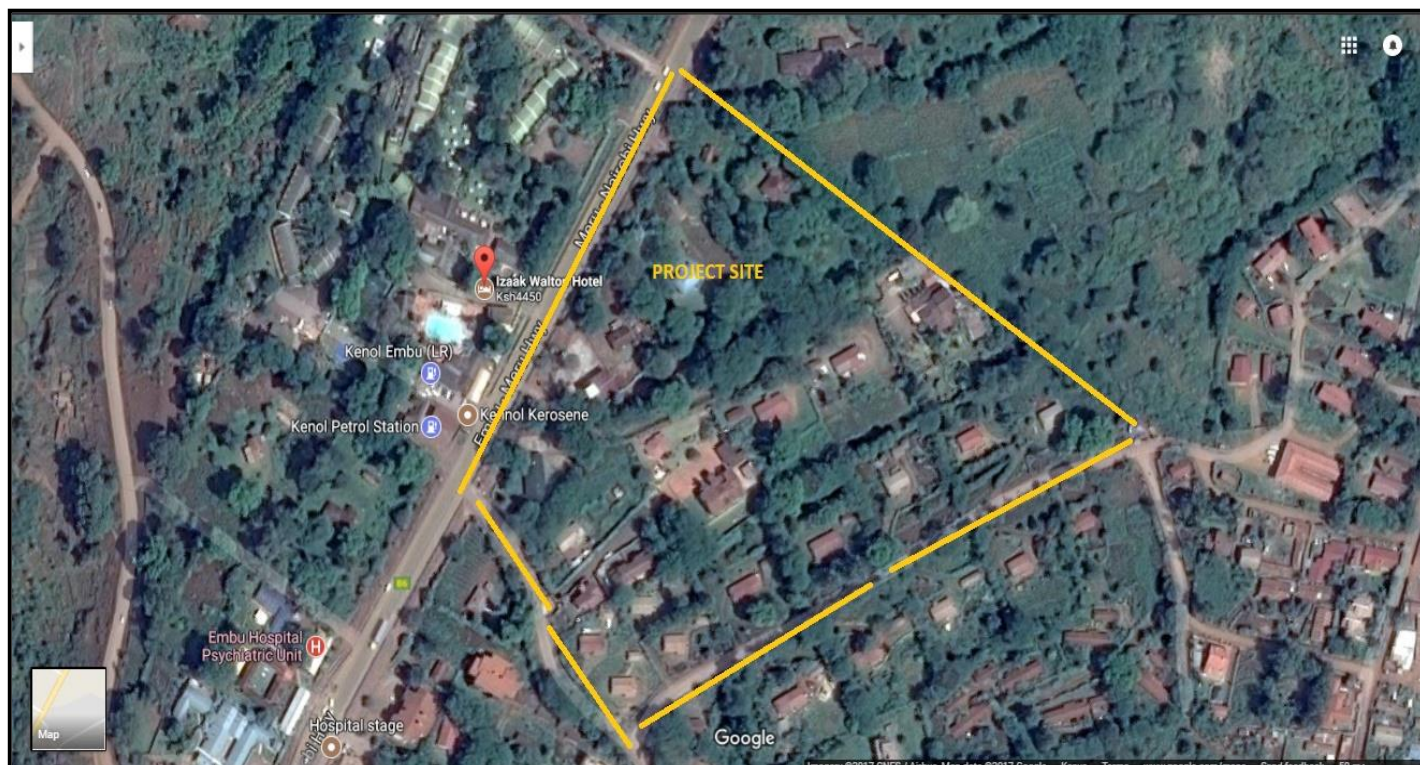




Ministry of Transport, Infrastructure, Housing & Urban Development

# ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FULL STUDY REPORT FOR THE PROPOSED CIVIL SERVANTS HOUSING SCHEME COMPRISING OF 220 2&3 BEDROOM UNITS IN EMBU TOWN, EMBU COUNTY

GPS coordinates 0.31'13.0"° S, 37.2717.0° E



OCTOBER 2017

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**ACRONYMS**

<b>OC:</b>	Degrees Celsius
<b>EA:</b>	Environmental Audit
<b>EIA:</b>	Environmental Impact Assessment
<b>EMCA:</b>	Environmental Management and Co-ordination Act
<b>EMP:</b>	Environmental Management Plan
<b>EMS:</b>	Environmental Management System
<b>KBS:</b>	Kenya Bureau of Standards
<b>NEC:</b>	National Environmental Council
<b>NEMA:</b>	National Environment Management Authority
<b>SHE:</b>	Safety Health and Environment
<b>SWM:</b>	Solid Waste Management
<b>TOR:</b>	Terms of Reference
<b>IEA:</b>	Initial Environmental Audit
<b>NBSAP:</b>	National Bio-diversity Strategy and Action Plan
<b>KPLC:</b>	Kenya Power and Lighting Company
<b>OHS:</b>	Occupational Health and Safety
<b>TOR:</b>	Terms of Reference
<b>EHS:</b>	Environmental Health and Safety
<b>KM</b>	Kilometers
<b>KPLC</b>	Kenya Power and Lighting Company
<b>PPE:</b>	Personal Protective Equipment



## DEFINITION OF ANALYTICAL TERMS

1. **Environmentally Sound Design:** Is the design and implementation of activities and projects such that the environmental harm associated with a particular development objective is kept to a practicable minimum.
2. **Positive Impact:** A change which improves the quality of the environment (for example by increasing species diversity; or improving the reproductive capacity of an ecosystem; or removing nuisances; or improving amenities).
3. **Neutral Impact:** A change which does not affect the quality of the environment.
4. **Negative Impact:** A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem, or property or by causing nuisance.
5. **Significant impact:** An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
6. **Profound impact:** An impact which obliterates sensitive characteristics.
7. **Do-Nothing Impact:** The environment as it would be in the future should no development of any kind be carried out.
8. **Indeterminable Impact:** When the full consequences of a change in the environment cannot be described.
9. **Irreversible Impact:** When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
10. **Residual Impact:** The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
11. **Synergistic Impact:** Where the resultant impact is of greater significance than the sum of its constituents.
12. **Worst Case Impact:** The impacts arising from a development in the case where mitigation measures substantially fail.
13. **Cumulative impacts:** Are identified as impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions.
14. **Indirect impacts:** Are defined as impacts on the environment which are not a direct result of the project, possibly produced some distance away from the project or as a result of a complex pathway.



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**EXECUTIVE SUMMARY**

The Ministry of Transport, Infrastructure, Housing and Urban Development wishes to demolish the existing fifteen (2) bungalows on its parcel of land along Embu- Meru road and redevelop it by putting up modern housing facilities for the civil servants purchase scheme. The existing bungalows house a total of fifteen families with each bungalow sitting on approximately an acre of land against the proposed high rise buildings that will accommodate two hundred and twenty families i.e. eighty (80) 2-bedroom units and one hundred and forty (140) 3-bedroom units. The ministry through the State Department for Housing and Urban Development therefore intends to maximize the use of the parcel of land by putting up the proposed housing project that will accommodate two hundred and twenty civil servants unlike the current ones which only accommodate fifteen civil servants. Kenya being a developing country is urbanizing very fast hence experiencing the challenges of urbanization thus the need for this kind of project that will optimize the use of this parcel of land. Consequently, before redevelopment it was found necessary to conduct an Environmental Impact Assessment study to establish the positive and negative impacts associated with the proposed project in relation to the environment. The GPS coordinates for the proposed project is GPS: 0.31'13.0"° S, 37.2717.0° E.

Due to numerous challenges of environmental degradation resulting from unsustainable implementation of development programs and projects, the Kenya government harmonized environmental laws under Environmental Management and Coordination Act (EMCA), 1999 for the purposes of coordinating environmental management. The EMCA 1999 (revised 2015) makes EIA mandatory for all the projects specified in the Second Schedule of the Act. It is in pursuit of this piece of legislation that the project proponent with the help of NEMA registered experts undertook this EIA project report.

**Public and stakeholder consultations**

Consultations were conducted with various stakeholders to gather their views about the proposed project. The following is a summary of the views from the consultation process:

- Generation, management and disposal of solid and liquid waste from the proposed development was of concern considering that the proposed project site is within town centre;
- Employment creation for local people.
- Noise disturbance to immediate neighbours;



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- Dust disturbance to immediate neighbours;
- Social impacts such school dropouts in favour of employment, teenage pregnancy, HIV and AIDS;
- Tree/vegetation coverage on site to be cut down to pave way for the project;
- Noise pollution during construction to be minimized to acceptable environmental levels;
- Dust during construction to be minimized to acceptable environmental standards;
- There should be no dumping of solid waste in unauthorized area;
- Use appropriate personal protective equipments for construction workers such as dust masks;
- Environmental friendly machines and equipment to be used to avoid environmental pollution;
- Construction work to be limited to daytime;
- Less dusty materials to be used;

**Potential Positive impacts**

Positive impacts likely to result from implementation of the proposed project will include the following among others:-

- Creation of jobs;
- Boosting of upmarket housing needs in Embu town;
- Boost of property value in Embu town;
- Affordable accommodation to more civil servants as opposed to the current housing that only accommodates fifteen civil servants;
- Lighting of locality;
- Support of local businesses;
- Infrastructure development; and
- Revenue to the county government

**Potential negative construction phase impacts**

- Dust nuisance during construction phase of the project;
- Noise nuisance during construction phase of the project;
- Vegetation loss;



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- Increase in vehicular traffic in the area both from construction vehicles as well as during operational phase of the facility;
- Increased demand for water and electricity supply to the area;
- Impacts of solid waste from the proposed apartment units ; and
- Impacts of sewage from the proposed apartment units.

**Proposed mitigation measures for the likely impacts**

<b>Expected negative impacts</b>	<b>Recommended mitigation measures</b>
Solid waste generation	<ul style="list-style-type: none"> <li>• Ensure solid generated at the house units are regularly disposed of appropriately at authorized dumping areas</li> <li>• Use of integrated solid waste management of options i.e. source reduction, recycling, composting and re-use, combustion and sanitary land filling</li> <li>• Ensure the occupants of the units manage their wastes effectively</li> <li>• A private company to be contracted to collect and dispose solid waste on regular basis</li> </ul>
Release of sewage to the environment	<ul style="list-style-type: none"> <li>• Use of the existing sewer line for effluent disposal</li> <li>• Apply for the license to NEMA for effluent disposal</li> <li>• Conduct regular inspection for the system to ensure it works effectively</li> </ul>
High demand for water	<ul style="list-style-type: none"> <li>• Create water conservation awareness</li> <li>• Install a discharge meter at water outlets to determine and monitor total water usage</li> <li>• Ensure water taps are not running when not in use</li> <li>• Residents to conserve water e.g. by avoiding unnecessary toilet flushing</li> <li>• Promptly detect and repair of water pipes and tank leaks</li> </ul>
Security	<ul style="list-style-type: none"> <li>• Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premise</li> </ul>
Fire control	<ul style="list-style-type: none"> <li>• Fire extinguisher to be placed strategic positions</li> <li>• Escape routes to be provided</li> <li>• Servicing of fire extinguishers as is necessary. Always inspect electricity wires</li> </ul>
High demand for electricity	<ul style="list-style-type: none"> <li>• Switch off electrical appliances and lights when not in use</li> <li>• Install occupational sensing lights at various locations such as storage areas which are not in use all the time</li> <li>• Install energy saving fluorescent tubes</li> </ul>



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	<ul style="list-style-type: none"> <li>• Monitor energy use during the operation of the project and set targets for efficient use</li> <li>• Sensitize housing units occupants to use energy efficiently</li> </ul>
Dust disturbance	<ul style="list-style-type: none"> <li>• Avoid excavation works in extremely dry weather</li> <li>• Regular sprinkling of water to be done on open surface and dusty grounds during dry season until paving is done;</li> <li>• Ensure strict enforcement of on-site speed limit regulations</li> <li>• Covering of all haulage vehicles carrying sand, aggregate and cement</li> <li>• Stockpiles of fine materials (e.g. sand and ballast) should be wetted or covered with tarpaulin during windy conditions.</li> <li>• Access roads and exposed ground must be wetted in a manner and at a frequency that effectively keeps down the dust.</li> <li>• Workers in dusty areas on the site should be issued with dust masks during dry and windy conditions</li> <li>• Providing appropriate enclosure for the concrete mixer and</li> <li>• Use of dust nets at high levels of the building</li> </ul>
Noise disturbance	<ul style="list-style-type: none"> <li>• Sensitize construction drivers to avoid running of vehicles engines or hooting especially when passing through sensitive areas such as church, schools or hospitals</li> <li>• Ensure the construction machinery are well kept in good condition</li> <li>• Sensitize construction drivers and machinery operators to switch off engines when not being used</li> <li>• Trees to be planted on site to provide some buffer against noise propagation</li> <li>• Ensure all generators and heavy machines are insulated or placed in an enclosure to minimize ambient noise levels</li> <li>• Restrict noisy construction activities to normal working hours (8am – 5pm).</li> <li>• Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of piling works.</li> <li>• Workers operating equipment that generate noise should be equipped with noise protection gear including ear muffs and plugs. Workers operating equipment generating noise levels greater than 80 dBA continuously for 8 hours or more should use earmuffs whereas those experiencing prolonged noise levels of 70 – 80 dBA should wear earplugs.</li> <li>• Limit pick up trucks and other small equipment to an idling time of five minutes, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.</li> <li>• All construction equipment should be regularly inspected and serviced</li> </ul>
Traffic control	<ul style="list-style-type: none"> <li>• Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of construction works.</li> <li>• As far as possible, transport of construction materials should be scheduled for off-peak traffic hours.</li> </ul>



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	<ul style="list-style-type: none"><li>• Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the main road in the vicinity of the entrance to the site during the construction period.</li><li>• Flagmen should be employed to control traffic and assist construction vehicles as they enter and exit the project site.</li><li>• Maintain on site a record of incidents and accidents</li></ul>
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**Environmental Management Plan for the proposed 220 apartments.**

The EMP developed for the proposed project will ensure that environmental pollution and or degradation does not occur as a result of implementation and operation of any of the components of the proposed development.

The EMP covers the following management plans among others:

- Solid waste management plan;
- Sewage management plan;
- Noise management plan;
- Dust management plan; and
- Occupational Hazards Management Plan;

The project proponent and contractor will need to undertake the following to ensure the success of the EMP:

- Develop and document environmental management policies that will guide construction work and other site operations during and after implementation of the project. These policies should address environmental conservation measures to be put in place, occupation health & safety and handling of waste generated by the project
- The project proponent to avail required finances for implementation of the EMP and ensure adherence to the EMP by the contractors implementing the project.
- The project contractors to adhere to the environmental management plan

**Environmental Monitoring Plan for the proposed Project**

This plan provides for both active and reactive monitoring of various environmental parameters including:

- (a) Monitoring of the achievements of specific plans of the Environmental Management Plan, performance criteria and fulfillment of objectives;
- (b) Systematic inspection of work place;



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- (c) Surveillance and monitoring of the work environment, including the organization of work and activities involved;
- (d) Monitoring of workers' health; and
- (e) Monitoring of compliance with laws, regulations and requirements.
- (f) Environmental conservation and related activities in the area;
- (g) Work related injuries, ill health (including record keeping and monitoring of sickness/absence), disease and accidents;
- (h) Losses such as damage to property;
- (i) Deficient safety and health performance including OHSMS failures;

**Decommissioning plan for the project.**

A conceptual programme for closure of the 220 apartment units is proposed as summarized:

<b>1. Demolition waste management</b>
All buildings, machinery, equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible
All foundations must be removed and recycled, reused or disposed of at a licensed disposal site
Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site
Donate reusable demolition waste to charitable organizations, individuals and institutions
<b>2. Rehabilitation of proposed project site</b>
Implement an appropriate re-vegetation programme to restore the site to its original status
Consider use of indigenous plant species adapted to geology and climate in re-vegetation

Considering the proposed project location, design and construction technology, operational management of the proposed civil servants scheme, capacity by the Ministry of Transport, Infrastructure, Housing and Urban Development to undertake this project, mitigation measures that will be put in place and the potential to boost housing in Embu town, the implementation of this project is of paramount importance and beneficial not only to the Ministry but also to the would be civil servant buyers or tenants. It is therefore our wish to recommend the project to go on with full compliance with the requirements of the law.



## CHAPTER ONE

### 1.0 INTRODUCTION

#### Background

For a very long time, many development projects worldwide didn't take into account the effects of projects on the environment. This led to much environmental degradation which caused environmental problems. Some of these problems have been irreversible and costly. In Kenya for instance, the policies, programs and strategies did not integrate environmental issues into development. A comprehensive environmental policy was therefore needed to take care of the environment in a holistic way. This was achieved through enactment of the Environmental Management and Coordination Act (EMCA), 1999. The Act stipulates that Environmental Impact Assessment be carried out on projects in the Second Schedule. It is in response to this provision that this project report has been prepared. The proposed project entails the construction of 220 apartments comprising of eighty (80) 2-bedroomed units and One hundred and forty (140) 3-bedroom units in Embu town, Embu County.

The Ministry of Transport, Infrastructure, Housing and Urban Development appointed the Environmental Impact Assessment (EIA) experts to carry out an EIA and prepare an Environmental Impact Assessment report according to the Environmental Management and Coordination Act (EMCA, 1999). The purpose of undertaking an EIA for the proposed project was to identify potential positive and negative environmental impacts associated with the proposed project and provide recommendations on how to mitigate the negative environmental impacts while maximizing on the positive impacts of the project.

The EIA team has evaluated the possible environmental, occupational health and safety impacts of the proposed project during design, construction, operation and decommissioning phases. The EIA project report has documented relevant and suitable methods of mitigating likely adverse impacts that may arise out of all the phases of the proposed project.

#### 1.1 Main Objective of the Project

The overall objective of the project is to demolish the current fifteen (15) houses on the site and build 220 housing units of 2&3 bedrooms units for the civil servants to occupy.





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### 1.2 Specific Objectives of the Project

This project seeks to achieve the following objectives:

- Boost the economy by building modern housing units on the site as opposed to the current ones.
- Maximize returns on investment for the Ministry while taking due consideration of policy, legal and administrative procedures governing the operations of a facility of this nature.
- To ensure that fears and hopes of the neighboring community in this environment is captured and addressed in all stages of the project's cycle.
- Ensure that implementation of the project does not in any way interfere with the environmental sustainability of the area in question giving due consideration to neighboring population and land uses.
- Put in place mitigation measures that will ensure that any potential negative impacts resulting from project activities are taken care of at the earliest opportunity to obviate any harmful effect to the neighboring populations and the environment.

### 1.3 Objectives of the EIA

The overall objective of the study is to assess the potential significant adverse impacts of the proposed development and articulate appropriate mitigation measures.

The specific objectives of this study include the following:

- To identify and evaluate the significant environmental impacts of the project
- To assess the environmental costs and benefits of the proposed project to the local and national economy.
- To determine the compatibility of the proposed facility with the local environmental setting.
- To evaluate and select the best project alternative from the various options.
- To propose mitigation measures for the negative environmental impacts
- To incorporate Environmental Management Plans and monitoring mechanisms during implementation, operation and decommissioning phases of the project.

### 1.4 Scope of the Study

The study has been conducted to evaluate the potential and foreseeable negative impacts of the proposed development. The physical scope is limited to the proposed site and the immediate environment as may be affected by or may affect the proposed project. Any potential impacts, are also evaluated as guided by EMCA 1999 and the Environmental (Impact Assessment and Audit) Regulations 2003. This



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report includes an assessment of impacts of the proposed site and its environs with reference to the following:

- A review of policy, legal and institutional framework.
- Description of the proposed project.
- Review of baseline information.
- Seeking views through Public participation and consultation.
- Assessment of the potential negative environmental impacts of the proposed project.
- Analysis of alternatives.
- Development of mitigation measures and future monitoring plans.
- Occupational and Environmental health and safety management.

### **1.5 Methodology**

The methodology used in the study comprised the following;

- A site reconnaissance and visual survey to determine the baseline information of the project area
- Briefing and consultation meetings with various stakeholders including, the Ministry's project manager, Engineers and project architects
- Local leadership including the current residents.
- Analysis of the project documents
- Assessment of the site to detail the various existing and likely impacts.
- Assessment of health and safety issues
- Seeking public views through both structured and unstructured interviews
- Proposal of mitigation measures to minimize any negative impacts.
- Preparation and submission of the report to NEMA for purposes of seeking an EIA approval and license



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## CHAPTER TWO

### PROJECT DESCRIPTION

#### 2.1 Introduction to the project

The Ministry of Transport, Infrastructure, Housing and Urban Development intends to put up 220 apartments units in Embu town and demolish the existing fifteen (2) bungalows on the site which are not economically viable. The 220 apartments will comprise of 2&3 bedroom units to cater for various tastes and preference of the intended civil servants who will buy them. The GPS coordinates for the proposed project is **GPS: 0.31'13.0''° S, 37.2717.0° E.**

In order to put up the development, the following activities will be undertaken: demolishing the existing bungalows, securing the site with a perimeter wall, clearing demolished debris, excavation works, cut and fill, and construction of the high rise buildings that will comprise the entire development.



Plate 1: Existing High grade bungalow



Plate 2: Existing medium grade bungalow



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### 2.2 Project components

The proposed 220 apartment units' project will have the following components:

- Perimeter wall around the site;
- transformer station
- Provision of solar energy for each unit in compliance with the Energy Act, 2012
- Water storage tanks



Plate 3: One of the sewer manholes on site

### 2.3 Composition of 220 Apartments

The following are some of the green features that have been incorporated into the design of the project:

- Hot water solar panels on the roof terrace will be used for heating of water for use in the rooms;
- Rain water harvesting will be incorporated in the implementation of the project to ensure that all water resources are tapped and used within the building;
- Skylights for natural lighting and ventilation within the building to reduce need for artificial lighting; and
- Landscaping and green parking slots.

### 2.4 Construction Equipment, Materials, Utilities and Waste

#### 2.4.1 Equipment

Equipment, machinery, materials and utilities that will be required for construction will be assembled on site. Equipment and machinery to be used will include dozers, excavators, dumpers, and cement mixers. A specific location within the site will be identified for holding these equipment. A specific site for holding construction tools and equipment will be identified within the boundary of the proposed project site.

#### 2.4.2 Materials

Materials to be used will include gravel, ballast, sand, cement, building blocks, steel bars of various types and sizes. All of these materials and others that may be needed will be sourced locally. A specific location within the proposed project site will be identified where materials for the construction work will be stored.



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### 2.4.3 Utilities

Utilities that will be required for the project include water, electrical energy and labour. The project proponent has two possible alternatives that can be exploited to meet the required demand for water. These are (in order of priority):-

- Have water supplied by the Embu Water and Sewage company (EWASCO); and
- Harness local ground water resources by sinking a borehole.

The two possible sources of water to the facility will effectively meet the anticipated demand. Just like in the case of water sources, there are three possible sources of electricity that the project proponent intends to exploit. These are:

- First priority is to source electricity from the national grid;
- Second priority will be installing power generators;
- Thirdly will be harnessing solar energy.

Electricity from the national grid will be the main supply to the proposed project. In case of shortage there will be standby generators. It is recommended that solar harnessing panels be incorporated in the project and that solar energy to be used for water heating purposes.

### 2.5 Waste Generation

Waste is likely to be generated during construction phase and later during operation phase. During construction phase the main types of solid waste likely to be generated will include the following excavated earth material/overburden off-cuts from timber, metal and other construction materials paper waste especially from cement packaging and sewage from sanitary facilities of construction workers.

- Ground excavation and trenching will generate considerable quantity of overburden materials. Some of the overburden may be containing important plant and animal genetic material, farther the overburden may also be containing materials of archaeological importance.
- Construction of the proposed project will generate waste material from off-cuts of timber, poles that will be used in form works, timber off-cuts are also likely to be generated from joinery works and internal finishing.
- Metal off-cuts/scrap will be generated during fabrication works and plumbing works.
- Paper waste likely to be generated during construction phase will mainly be from packing of cement;



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- Sewage during construction phase will be generated from sanitary facilities of construction workers.

During operation phase waste likely to be generated from the proposed apartments may include the following:-

- Electronic waste such as absolute electronic equipment
- Paper waste will include old newsprint, paper wrappings.
- Sewage from sanitary facilities within the development;
- Waste from the kitchens which will mainly be food based waste;
- Wastewater from the apartments;
- Old linen from the households.

**2.5.1 Waste Management and Disposal**

- All solid waste generated either during construction or operation phase should be managed and disposed according to the requirements of the Environmental Management and Coordination (Waste Management) Regulations 2006;
- All liquid waste generated either during construction or operation phase should be managed and disposed according to the requirements of the Environmental Management and Coordination (Water Quality) Regulations 2006;
- Overburden material realized from ground excavation works and trenching should be held in a temporally site where it should be available for later use in landscaping and gardening works once construction activities are complete;
- Timber off-cuts realized can be used as fuel/fire wood and hence should be sold for the same and or donated to local people for use as fire wood;
- Metal off-cuts and all other metallic waste realized from the construction should be sold as scrap to scrap dealers;
- Paper waste especially that from cement packaging should be collected and disposed at NEMA licensed disposal sites;
- Old linen from kitchen and rooms can be donated or where applicable reused. Very old linen that cannot be used can be disposed along side with other solid waste;



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- A NEMA licensed solid and liquid waste collection and disposal company to be contracted to collect and dispose all liquid and solid waste from the site;
- Grease traps to be provided for in the kitchen wash areas, the grease traps should be cleaned regularly;
- Kitchen waste to be collected by NEMA licensed companies and disposed at NEMA licensed sites;
- Waste handling bins with lids to be provided at various utility points within the site for dropping of waste;
- All waste bins to be regularly emptied;
- Where applicable colour codes and labeling to be used on waste bins of different types;
- Waste sorting to be done at source before disposal.

#### **2.6 Technology to be used**

During construction it is expected that dust disturbance will be of concern to neighbours. Noise disturbance is likely to be also of concern too. The contractor who will undertake construction of the proposed project will be required to use appropriate technology that will reduce possible dust and noise disturbances. Noise levels within the construction site should be within the prescribed limits of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

#### **2.7 Dust Control Technology**

Dust disturbance is a major challenge in construction industry. There are ways in which dust can be arrested. The available technologies of controlling dust pollution in construction industry include the use of dust screens. The effectiveness of the screens depends on their size. Very fine screens are more effective than less fine ones. Further the effectiveness of the screens will depend on how well the construction site is covered. Regular replacement of worn out dust screens will be essential in controlling dust pollution.

#### **2.7 Noise Reduction Technology**

Construction work utilizes heavy machinery. Some of these machines can be a potential source of noise. The contractor must ensure that he utilizes available noise reduction technology to reduce possible noise pollution. This can be achieved by utilizing noise reduction device technology. This technology involves fitting silencers in machines that produce much noise. Silencers are very effective in reducing noise pollution. Further siting of machines relative to the neighborhood will also determine the level of noise disturbance to the neighborhood.





## CHAPTER THREE

### 3.0 ANALYSIS OF ALTERNATIVES

Analysis of alternatives of the proposed 220 apartment units covers the following:-

- a) Project alternatives;
- b) Design alternatives;
- c) Alternative use of proposed project site; and
- d) Alternative project site.

#### 3.1 Project Alternatives

There are two project alternatives i.e. not to undertake the project (no project alternative) and to undertake the project (yes project alternative). The two project options are analyzed below:-

##### 3.1.1 The “no project” alternative

This option will mean that the project will not be undertaken. This implies that the proposed apartment units will not be undertaken. This implies that all potential civil servant buyers who were to use the facility will have to be either halted or alternative facility be sourced.

In analyzing this option the following was considered:-

- **Technology transfer;** implementation of the proposed apartments will see transfer of various technologies to our people locally. This includes design technologies for wastewater treatment and renewable energy incorporation in buildings. Therefore the ‘no project’ alternative will not be favorable to this realization;
- **Contribution to local housing needs;** it is the government policy to improve and provide housing for its citizens. One way of achieving this is by the government undertaking to construct houses for its citizens in order to meet the rising housing demand in the country. The proposed apartments if implemented will contribute to meeting housing needs in Embu town. The no project alternative will negate this potential gain from the proposed project if implemented.
- **Employment creation,** the current government policy on employment and wealth creation aims at creating as many jobs as possible to meeting the ever increasing employment demand in the country. If the ‘no project option’ was to be considered then this government target may not be realized.



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- **Investor attraction**, if the no option is considered it will not be consistent with the government aim of attracting investments in the country and especially encourage local private investment in tourism and housing sectors to contribute to addressing rising demand for descent housing in the country.
- **Financial investment**: The 'no' option will mean that possible occupants of the proposed apartments will have to wait or invest their monies elsewhere;
- **Income to government** Income in form of taxes to the central/county government will not be realized.

Therefore if the no option will be pursued it is likely that we may lose more than what is to be gained if the proposed project is to be implemented.

#### 3.1.2 The 'yes' project alternative

This was considered to be a viable option. This option was considered viable as opposed to the 'no option' because the yes project alternative implies that the project be implemented and once implemented there will be a number of gains that will be realized including the following:

- Boost on investor confidence in housing sector;
- More jobs will be created;
- It will result in further development and improvement of local infrastructure;
- There will be increased revenue inform of taxes to the government;
- It will inject an additional 220 units in the area; and
- It will be a landmark development in Embu town by the government.

#### 3.2 Design alternatives

Design alternatives for the proposed apartments units covers alternative building design and alternative designs of sewage management system.

##### 3.2.1 Preferred building design

The preferred design for the building is blocks three storeyed buildings. This design is preferred because of the following:-

- High density development can be achieved with storey buildings;
- The topography of the land is fully exploited;
- Above ground space will be utilized as opposed to the current non-storey building;
- A storey building will occupy less ground space as opposed to non-storey; and



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- More ground space will be available for gardening and parking as opposed to non-storey building.

**3.2.2 Alternative building design**

Alternatively, the building can be of a multi- storey design or non-storey.

Advantages of single storey building include:-

- Causes minimal obstruction;
- Easy to built using simple tools and equipments;
- Less prone to collapsing in event of tremors or poor workmanship compared to high-rise building.

Disadvantages of single storey building include:-

- Maximum land value is not realized;
- Less above ground space is utilized ;
- Minimal units can be built in a given space;
- Maximum economic returns from a given space cannot be realized;
- Fewer people can be accommodated in a given area.

Advantages of multi-storey building

- Maximum returns on land value can be attained;
- Many units can be built in a given space;
- Maximum utilization of above ground space can be achieved;
- Both beneath ground and above ground spaces can be effectively utilized for maximum economic returns;
- Local aesthetics is changed for the better.

Disadvantages of multi-storey building

- Visual obstruction ;
- More prone to effects of tremors and earthquakes;
- Requires sophisticated equipment to build.

In light of the above analysis, storey building will be preferred to non-storey because:-

- Land is a finite resource; to attain maximum use of it will be prudent to encourage storey proposed apartment units as opposed to non-storey since we cannot increase available land space, what is left is to find ways of sustainable and effectively utilizing of the available finite space for maximum returns;
- In order to address housing needs in a rapidly developing urban setting storey building will be more effective in addressing these need as more people can be accommodated in a given space;



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- It will be more cost effective to invest in storey building in the present than wait in the future when there will be no room

**3.3 Preferred design for the sewage management system**

The proposed apartment units propose to use the existing sewer system by Embu Water and Sewerage Company to manage sewage from the facility.

**3.4 Alternative use of proposed project site**

**3.4.1 Preferred use**

The preferred use of the proposed project site is to construct 220 apartment units. This is the preferred use because of the following:-

- The proposed project site has ample space to accommodate all components of the proposed apartment units ;
- Topography of the land is gentle

**3.4.2 Alternative use of proposed project site**

Other alternative use of the proposed project site may include the following:-

- The site can be maintained in its current use single dwellings;
- The site can be used for conservation work by developing it to a botanic garden;

**3.4.3 Alternative project site**

Alternative sites for construction of the proposed project site may have to be:-

- In ownership by the project proponent or an associate; and
- Accessible with essential infrastructure.

Such alternatives sites meeting the above criteria did not belong to the Ministry and thus deemed unfeasible for development of the proposed project.



## CHAPTER FOUR

### POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

#### 4.1 General Overview

Kenya has a policy, legal and administrative framework for environmental management. Under the framework, the National Environment Management Authority (NEMA) is responsible for ensuring that environmental impact assessments (EIAs) are carried out for new projects and environmental audits on existing facilities as per the environmental management and coordination Act 1999.

EIAs are carried out in order to identify potential positive and negative impacts associated with the proposed project with a view to taking advantage of the positive impacts and developing mitigation measures for the negative ones. The guidelines on EIAs are contained in Sections 58 to 67 of the Act.

According to Section 68 of the Environmental Management and Coordination Act (EMCA) 1999, The Authority shall be responsible for carrying out environmental audits on all activities that are likely to have a significant effect on the environment.

Environmental auditing (EA) is a tool for environmental conservation and has been identified as a key requirement for existing facilities to ensure sustainable operations with respect to environmental resources and socio-economic activities in the neighborhood of the facilities.

The government has established regulations to facilitate the process on EIAs and environmental audits. The regulations are contained in the Kenya Gazette Supplement No. 56, Legislative Supplement No. 31, and Legal Notice No. 101 of 13<sup>th</sup> June 2003.

In the past, the government has established a number of National policies and legal statutes to enhance environmental conservation and sustainable development.

***The proponent will need to observe the provisions of the various statutes that are aimed at maintaining a clean, healthy and sustainable environment.***

Some of the policy and legal provisions are briefly presented in the following sub-Sections



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### 4.2 Policies

#### 3.2.1 National Environmental Action Plan (NEAP)

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programmes that disregarded environmental sustainability. Following on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. Under the NEAP process Environmental Impact Assessments were introduced targeting the industrialists, business community and local authorities.

#### 4.2.2 National Policy on Water Resources Management and Development

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

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

In addition, the policy provides for charging levies on wastewater on the basis of quantity and quality. The "polluter-pays-principle" applies in which case parties contaminating water are required to meet the appropriate cost of remediation. The policy provides for establishment of standards to protect water bodies receiving wastewater, a process that is ongoing.

#### 4.2.3. Policy Paper on Environment and Development (Sessional Paper No. 6 of 1999):

The key objectives of the Policy include: -

- To ensure that from the onset, all development policies, programmes and projects take environmental considerations into account,



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- To ensure that an independent environmental impact assessment (EIA) report is prepared for any industrial venture or other development before implementation,
- To come up with effluent treatment standards that will conform to acceptable health guidelines.

Under this paper, broad categories of development issues have been covered that require a “sustainable development” approach. These issues relate to waste management and human settlement. The policy recommends the need for enhanced re-use/recycling of residues including wastewater, use of low or non-waste technologies, increased public awareness and appreciation of a clean environment. It also encourages participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others.

#### 4.3 Legal Aspects

The key national laws that govern the management of environmental resources in the country have been briefly discussed in the following paragraphs. Note that wherever any of the laws contradict each other, the Environmental Management and Coordination Act 1999 prevails.

##### 4.3.1 The Environment Management and Coordination Act, 1999 revised 2015

Part II of the Environment Management & Coordination Act, 1999 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment.

According to Section 58 of the Act an Environmental Impact Assessment study needs to be carried out on projects specified in the second schedule of the Act that are likely to have a significant impact on the environment. ***It is in line with this provision that the proponent has appointed the EIA/Audit experts to carry out an EIA report and prepare a project report in respect of the proposed apartments.***

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 project proponent will need to prepare and submit an environmental audit report in the first year of occupancy to confirm the efficacy and adequacy of the Environmental Management Plan.***





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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.

Section 102 states that subject to provisions of the civil aviation Act, any person who emits noise in excess of the noise emission standards established under this part commit an offence.

***The proponent will have to ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as sewerage connections, solid waste management plans, and landscaping and aesthetic improvement programmes are implemented, as per the design and maintained throughout the project cycle.***

**4.3.2 The Water Act 2002**

Part II Section 18 of this Act provides for national monitoring and information systems on water resources. In addition, sub-Section 3 allows the Water Resources Management Authority to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by a site operator and the information thereof furnished to the authority. Section 73 of the Act allows a person with license (licensee) to supply water to make regulations for purposes of protecting against degradation of water sources. Section 75 and sub-Section 1 allows the licensee to construct and maintain drains, sewers and



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other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

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

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

***The project Proponent will be required to ensure that all construction waste are collected and dumped at approved sites to prevent potential for contaminating surface and underground water sources. All hazardous materials will need to be kept in a store with concrete floor. In addition, maintenance of fuel powered equipment and/or vehicles should be done off-site***

**4.3.3 The Public Health Act (Cap. 242)**

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

Such nuisance or conditions are defined under Section 118 waste pipes, sewers, drains or refuse pits in such a state, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to health. Any noxious matter or waste water flowing or discharged from any premises into a public street or into the gutter or side channel or watercourse, irrigation channel or bed not approved for discharge is also deemed as a nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbor rats or other vermin. ***The Proponent will be required to abide by these provisions throughout the project cycle.***

On the responsibility of local authorities, Part XI Section 129 of the Act states in part “It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for



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preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes...”

Section 130 provides for making and imposing regulations by the local authorities and others the duty of enforcing rules in respect of prohibiting use of water supply or erection of structures draining filth or noxious matter into water supply as mentioned in Section 129. This provision is supplemented by Section 126A that requires local authorities to develop by-laws for controlling and regulating among others private sewers, communication between drains and sewers and between sewers as well as regulating sanitary conveniences in connection to buildings, drainage, cesspools, etc. for reception or disposal of foul matter.

Part XII Section 136 states that all collections of water, sewage, rubbish, refuse and other fluids which permits or facilitate the breeding or multiplication of pests shall be deemed nuisances and are liable to be dealt with in the manner provided by this Act.

***The occupants will be required to contract a licensed solid waste transporter or the county government to transport all solid waste from the site for dumping at approved sites. Sewage from the site will be discharged through the existing sewer line.***

**4.3.4 The County Government Act, 2012**

Section 160 helps county governments ensure effective utilization of the sewerage systems. It states in part that municipal authorities have powers to establish and maintain sanitary services for the removal and destruction of, or otherwise deal with all kinds of refuse and effluent and where such service is established, compel its use by persons to whom the service is available.

Section 163 (e) gives powers to the local Authorities to prohibit businesses which by reason of smoke, fumes, chemicals, gases, dust, smell, noise, vibration or other cause, may be or become a source of danger, discomfort or annoyance to the neighborhood, and to prescribe conditions subject to which such business shall be carried on.

***The appointed contractor and the Proponent will mitigate against such impacts by ensuring strict adherence to the Environmental Management Plan provided in this project report throughout the project cycle.***

Section 165 empowers the county government to grant or to renew business licenses or to refuse the same. Section 170, allows the right of access to private property at all times by local authorities, its officers and servants for purposes of inspection, maintenance and alteration or repairs of sewers. To ensure sustainability in this regard, the local authority is empowered to make by-laws in respect of all



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such matters as are necessary or desirable for the maintenance of health, safety and well being of the inhabitants of its area as provided for under Section 201 of the Act.

Section 173 states that any person who, without prior consent in writing from the council, erects a building on; excavate or opens-up; or injures or destroys a sewers, drains or pipes shall be guilty of an offence. Any demolitions and repairs thereof shall be carried out at the expense of the offender.

The Act under Section 176 gives power to the local authority to regulate sewerage and drainage, fix charges for use of sewers and drains and require connecting premises to meet the related costs. According to Section 174, any charges so collected shall be deemed to be charges for sanitary services and will be recoverable from the premise owner connected to the facility. Section 264 also requires that all charges due for sewerage, sanitary and refuse removal shall be recovered jointly and severally from the owner and occupier of the premises in respect of which the services were rendered. This in part allows for application of the “polluter-pays-principle”.

**4.3.5 The Physical Planning Act, Cap 286**

The Local Authorities are empowered under Section 29 of the Act to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same Section, therefore, allows for prohibition or controls the use and development of land and buildings in the interest of proper and orderly development of an area.

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

***The architectural plans for the proposed apartments will be submitted to Embu County Government***

Finally, Section 36 states that if in connection with a development application, local authority is of the opinion that the proposed development activity will have injurious impact on the environment; the applicant shall be required to submit together with the application an environmental impact assessment (EIA) report. EMCA, 1999 echoes the same by requiring that such an EIA is approved by the National Environmental Management Authority (NEMA) and should be followed by annual environmental audits.

***The proponent has complied with this provision by appointing EIA/Audit experts to prepare and submit this Environmental Impact Assessment project report to the Authority.***



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**4.3.6 The Land Planning Act (Cap. 303)**

Section 9 of the subsidiary legislation (The development and use of land regulations 1961) under this Act requires that before the local authorities submit any development plans to the Minister for approval, steps should be taken as may be necessary to acquaint the owners of any land affected by such plans. Particulars of comments and objections made by the landowners should also be submitted. This is intended to reduce potential conflict between the interests of the authorities and those of landowners in respect of settlement, social and economic activities.

**4.3.8 The Building Code 2000**

Section 194 requires that where a sewer exists, the occupants of the nearby premises shall apply to the local authority for a permit to connect to the sewer line and that all wastewater must be discharged into the sewers. The code also prohibits construction of structures or buildings on sewer lines.

**4.3.9 The Penal Code (Cap. 63)**

Section 191 of the Penal Code states that any person or institution that voluntarily corrupts or foils water of public springs or reservoirs rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighborhood or those passing along public way commit an offence.

***The Proponent will be required to ensure strict adherence to the Environmental Management Plan throughout the project cycle in order to mitigate against any possible negative impacts.***

**4.3.10. The Occupational Safety and Health Act, 2007**

This is an act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. The Act was published in the Kenya Gazette Supplement No. 111 (Acts No.15). It received presidential assent on 22<sup>nd</sup> October, 2007 and became operational on 26<sup>th</sup> October, 2007.

The key areas addressed by the Act include:

- i) General duties including duties of occupiers, self employed persons and employees
- ii) Enforcement of the act including powers of an occupational safety and health officer
- iii) Registration of workplaces
- iv) Health General Provisions including cleanliness, ventilation, lighting and sanitary conveniences



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- v) Machinery safety including safe handling of transmission machinery, hand held and portable power tools, self acting machines, hoists and lifts, chains, ropes & lifting tackle, cranes and other lifting machines, steam boilers, air receivers, refrigeration plants and compressed air receiver
- vi) Safety General Provisions including safe storage of dangerous liquids, fire safety, evacuation procedures, precautions with respect to explosives or inflammable dust or gas
- vii) Chemical safety including the use of material safety data sheets, control of air pollution, noise and vibration, the handling, transportation and disposal of chemicals and other hazardous substances materials
- viii) Welfare general provisions including supply of drinking water, washing facilities, and first aid
- ix) Offences, penalties and legal proceedings

Under section 6 of this act, every occupier is obliged to ensure safety, health and welfare of all persons working in his workplace. The occupier shall achieve this objective by preparing and as often as may be appropriate, revising a written statement of his general policy with respect to the safety and health at work of his employees and the organization and arrangements for the time being in force for carrying out that policy (Section 7). He is also required to establish a safety and health committee at the workplace in a situation where the number of employees exceeds twenty (section 9) and to cause a thorough safety and health audit of his workplace to be carried out at least once in every period of twelve months by a registered safety and health Advisor (Section 11). In addition, any accident, dangerous occurrence, or occupational poisoning which has occurred at the workplace needs to be reported to the occupational safety and health officer of the respective area by an employer or self-employed person (section 21).

According to section 44, potential occupiers or users of any premises as work places are required to apply for registration to the Director for all premises intended for use as workplaces. Such places shall be maintained in a clean state during the operation phase (section 47).

To ensure machinery safety, every hoist or lift – section 63 and/or all chains, ropes and lifting tackles – section 64 (1d), shall be thoroughly examined at least once in every period of six months by a person approved by the Director of Occupational Health and Safety Services. Similarly, every steam boiler - section 67 (8) and/or steam receiver - section 68 (4) and all their fittings and/or attachments shall be thoroughly examined by an approved person at least once in every period of twelve months whereas every air receiver shall be thoroughly cleaned and examined at least once in every period of twenty four months or after any extensive repairs - section 69 (5). According to section 71 (3), every



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refrigeration plant capable of being entered by an employee also needs to be examined, tested and certified at least once in every period of twelve months by an approved person.

In relation to fire safety, section 78 (3) requires spillage or leaks of any flammable liquid to be contained or immediately drained off to a suitable container or to a safe place, or otherwise treated to make it safe. Furthermore, a clear and bold notice indicating that smoking is prohibited should be conspicuously displayed in any place in which explosive, highly flammable or highly combustible substances, are manufactured, used, handled or stored-section 78 (5). In addition, necessary precautions for dealing with fire incidents should be implemented including provision of means for extinguishing fire and means for escape, in case of fire, for the persons employed in any workplace or workroom – section 81. As far as disaster preparedness and emergency response program is concerned, section 82 (1) makes it a mandatory requirement for every occupier of a workplace to design evacuation procedures to be used during any emergency situation and to have them tested at regular intervals.

To promote health and safety of employees who are at risk of being exposed to chemical substances, section 84 (3) and 85 (4) requires every employer to maintain at the workplace material safety data sheets and chemical safety data sheets respectively for all chemicals and other hazardous substances in use and ensure that they are easily available to the employees.

The employers' positive contribution towards the welfare of the employees include provision and maintenance of adequate supply of wholesome drinking water - section 91 and a first aid box or cupboard of the prescribed standard – section 95 at suitable point (s) conveniently accessible to all employees.

Other precautionary measures include: issuance of a permit to work to any employee, likely to be exposed to hazardous work processes or hazardous working environment, including such work processes as the maintenance and repair of boilers, dock work, confined spaces, and the maintenance of machinery and equipment, electrical energy installations, indicating the necessary precautions to be taken – section 96 (1); provision and maintenance for the use of employees, adequate, effective and suitable protective clothing including suitable gloves, footwear, goggle and head coverings in any workplace where employees are likely to be exposed to wet, injurious or offensive substance – section 101 (1).





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*The proponent will be required to ensure that the main contractor includes in the contract document, adequate measures to promote safety and health of workers during the construction phase of the proposed project.*

**4.3.11. The Environmental Management and Co-ordination (Water Quality) Regulations, 2006.**

These Regulations were published in the Kenya Gazette Supplement No. 68, Legislative Supplement No. 36, and Legal Notice No. 120 of 29<sup>th</sup> September, 2006. The Regulations provides for sustainable management of water resources including prevention of water pollution and protection of water sources (lakes, rivers, streams, springs, wells and other water sources).

It is an offence under Regulation No. 4 (2), for any person to throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution.

Regulation No. 11 further makes it an offence for any person to discharge or apply any poison, toxic, noxious or obstructing matter, radio active waste or other pollutants or permit the dumping or discharge of such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards for effluent discharge into the environment

Regulation No. 14 (1) requires every licensed person generating and discharging effluent into the environment to carry out daily effluent discharge quality and quantity monitoring and to submit quarterly records of such monitoring to the Authority or its designated representatives.

*The proponent will have to ensure that appropriate measures to prevent pollution of underground and surface water sources are implemented throughout the project cycle.*

**4.3.12. The Environmental Management and Co-ordination (Waste Management) Regulations, 2006.**

These Regulations were published in the Kenya Gazette Supplement No. 69, Legislative Supplement No. 37, Legal Notice No. 121 of 29<sup>th</sup> September, 2006. The regulations provide details on management (handling, storage, transportation, treatment and disposal) of various waste streams including:

- domestic waste
- industrial waste,
- hazardous and toxic waste
- pesticides and toxic substances



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- biomedical wastes and
- radioactive waste

Regulation No. 4 (1) makes it an offence for any person to dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle.

Regulation 5 (1) provides categories of cleaner production methods that should be adopted by waste generators in order to minimize the amount of waste generated and they include:

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

***The Proponent shall ensure that the main contractor adopts and implements all possible cleaner production methods during the construction phase of the project.***

Regulation 6 requires waste generators to segregate waste by separating hazardous waste from non-hazardous waste for appropriate disposal

Regulation 14 (1) requires every trade or industrial undertaking to install at its premises anti-pollution equipment for the treatment of waste emanating from such trade or industrial undertaking

Regulation 15 prohibits any industry from discharging or disposing of any untreated waste in any state into the environment

Regulation 17 (1) makes it an offence for any person to engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment license issued by NEMA

Regulation 18 requires all generators of hazardous waste to ensure that every container or package for storing such waste is fixed with a label containing the following information:

- The identity of the hazardous waste
- The name and address of the generator of waste



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- The net contents
- The normal storage stability and methods of storage
- The name and percentage of weight of active ingredients and names and percentages of weights of other ingredients or half-life of radioactive material
- Warning or caution statements which may include any of the following as appropriate-
  - the words “WARNING” or “CAUTION”
  - the word “POISON” (marked indelibly in red on a contrasting background; and
  - the words “DANGER! KEEP AWAY / NO ENTRY FOR UNAUTHORIZED PERSONS” and
  - a pictogram of a skull and crossbones

Regulation 19 (1) requires every person who generates toxic or hazardous waste to treat or cause to be treated such hazardous waste.

***During the construction phase of the project, the Proponent shall ensure that the main contractor implements the above mentioned measures as necessary to enhance sound environmental management of waste.***

**4.3.13 Noise and Excessive Vibration Pollution control Regulations, 2009**

The regulations states that;

- No person shall make, continue or cause to be made or continue any noise in excess of the noise levels set in the First Schedule to the Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.
- No person shall cause noise from any source which exceeds any sound level as set out in the application column in the First Schedule to the Regulations. Any person who makes noise in excess of the prescribed levels commits an offence.



## CHAPTER FIVE

### 5.0 BASELINE INFORMATION

#### 5.1 INTRODUCTION

Baseline information is needed on all central issues in the Environmental assessment, taking into account a broad definition of the environment. Baseline information provides a reference for all assessments, for accurately predicting and for the comparison of alternatives and mitigation measures. It is used as a starting point in the prediction of likely impacts resulting from the project and of naturally occurring changes in the environment. Baseline information was collected from documents and data banks, supplemented by field studies.

The environmental resources examined in baseline analysis include:

- a) Physical resources (climate, soils geology, ground water and surface water)
- b) Ecological resources (aquatic biology e.g. fisheries, wildlife, forests and endangered vegetation species, protected coastal resources.
- c) Economic development (infrastructural facilities such as water supply, sewerage, flood control, roads, land use, power sources, agricultural development, mining and tourism).
- d) Social and cultural resources (e.g. population numbers, locations, composition, employment, health facilities, socio-economic conditions e.g. social well being, physical or cultural heritage, current use of lands and resources for traditional purposes by indigenous people, sites that are for historical, archeological, paleontological or architectural significance.



The proposed project is located in Embu county Embu town along Embu-Meru road, between KARI and the Embu level 5 hospital.

**Plate 4: Map of Embu County where the proposed project is located**



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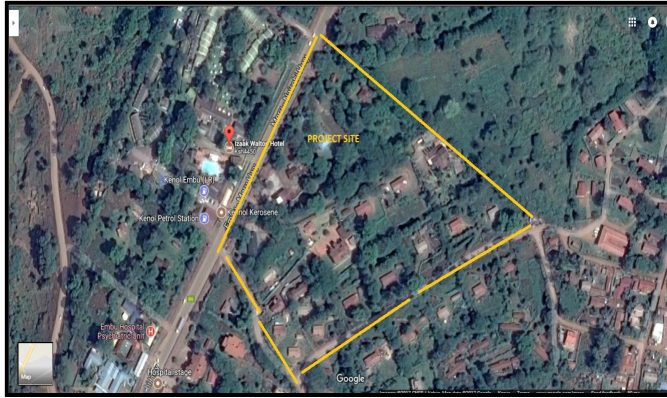


Plate 5: Google map showing project location and boundaries

Plate 6: Embu-Meru road along the project



Plate 7



Plate 8

Plates 7&8 Existing murrum roads and vegetation within the project site



## **5.2 Physical Resources**

### **5.2.1 Topography**

The proposed project is located within Embu town. Embu County slopes from North-West towards East and South-East with a few isolated hills such as Kiambere, Kianjiru and Kiang'ombe which rise above the general height and slope. The County is characterized by highlands and lowlands. It rises from about 515m above sea level at the Tana River basin in the East to over 4,570m above sea in the North West which is part of Mt. Kenya. Between Embu town and Thũci river lies an area with an altitude ranging from 910m to 1,525m above sea level. The Southern part of the County is covered by Mwea plains. It then rises Northwards, culminating in hills and valleys to the Northern and Eastern parts.

### **5.2.2 Geology**

The geology of the area is characterized by volcanic soils in the upper part and red loam and clay soils in the lower parts of the supply area corresponding to Mt. Kenya ecosystem.

### **5.2.3 Hydrogeology**

Embu County is served by six major rivers which are Thuci, Tana, Kii, Rupingazi, Thiba and Ena which form part of the Embu County's boundaries. All these rivers are perennial. River Tana originates from Aberdare Ridges. There are also some major dams which generate hydroelectric power for the country that are partly in the county. These include Masinga, Kiambere, Kindaruma and Gitaru dams which are situated along the Tana River. Geo-physical survey indicates that the potential for ground water is high and the yields are quite adequate though this may not be the case in the near future due to encroachment of catchment areas.

### **5.2.4 Soils**

The larger Embu County has an agro ecological profile that is typical of the windward side of Mt. Kenya. At the peak of Mt. Kenya, the soils are imperfectly drained; shallow to moderately deep, and dark reddish brown in colour, very friable, acid humid to peaty, loam to clay with rock outcrops and ice in the highest parts with no major economic activity. The upper highlands are so wet and steep that forestry is the best land use. The forest reserve zone is characterized by humid soils which are well drained, very deep, dark reddish brown to dark brown, clay loam to clay with a thick acid humid top soil. They then gradually evolve into volcanic foot ridges which have soils developed on basic igneous





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rocks. These soils include humid nitisols with humid andosols found in parts of Manyatta, Nembure, Runniness and Kyeni Divisions. These are well suited for tea and coffee growing.

### **5.2.5 Climate**

The rainfall pattern is bi-modal with two distinct rainy seasons. Long rains occur between March and June while the short rains fall between October and December. Rainfall quantity received varies with altitude averaging to about 1067.5mm annually and ranging from 640mm in some areas to as high as 1,495mm per annum. At higher altitudes, (above 1700m), the pattern changes to tri-modal. Temperatures range from a minimum of 12 °C in July to a maximum of 30 °C in March with a mean of 21 °C.

The extensive altitudinal range of Embu County influences temperatures that range from 20 °C to 30 °C. July is usually the coldest month with an average monthly temperature of 15 °C while September is the warmest month with an average monthly temperature rising to 27.1 °C. There is however localized climate in some parts of the County especially the Southern region due to their proximity to the Masinga, Kamburu, Gĩtaru, Kĩndaruma and Kĩambere dams

### **5.2.6 Ecological Resources**

#### **5.2.7 Vegetation/ Forests**

The county has gazetted and non-gazetted forests. Mt. Kenya forest is the only gazetted forest in the county. It is an expansive mountainous forest that traverses a number of counties. The county has only one gazetted and four non gazetted forests which are Kiang'ombe, Kirimiri, Kianjiru and Kiambere with a total of 3,751ha. The main forest products include timber, poles, firewood, carvings, charcoal, posts, seedlings and honey. The high dependency on firewood and charcoal may result to depletion of forest cover in the county which is also aggravated by increased land subdivisions

### **5.3 Social and Cultural Resources**

#### **5.3.1 Population characteristic**

Embu County's population was estimated to be 543,221 persons, 267,609 male and 275,612 female, with an estimated annual growth rate of 1.7 percent based on the 2009 Kenya Population and Housing Census (KPHC).

The youth who comprise those between 15 and 34 years represent 34.5 per cent of the total population. The age group distribution shows that the population aged less than 15 years comprises 37.5 per cent of the total population. The sex ratio in the county stands at 1:1 which shows an equal



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female and male population. The dependant population comprising of those below 15 years and above 64 years of age constitutes 42.6 per cent of the population.

**5.4.1 Agriculture and Rural Development**

The Agriculture and Rural Development Sector comprises the following sub-sectors: Agriculture, Livestock, Fisheries Development, Cooperatives, Lands, forestry and wildlife. The sector contributes about 60% to the County's economy and therefore plays a major role towards poverty reduction and creation of employment Opportunities. The sector is expected to play a significant role towards achievement of the targets set in the then Development Plan 2008-2012. The goals of the sector include: creation of an enabling environment for competition; enhanced efficiency and effectiveness in service delivery; and ensuring sustainable management of resources. The strategic objectives of the sector include, raising productivity and profitability through efficient allocation of resources; accelerating growth for sustainable socio-economic development; and creating an enabling environment for effective private sector participation.

Agriculture is the backbone and livelihood of the people of Embu County. The sector employs 70.1 per cent of the population and 87.9 per cent of the households are engaged in Agricultural activities. The upper part of Embu County relies mainly on cash crops such as coffee and tea while the lower part mainly produces food crops such as maize, beans, cow peas, bananas, sorghum, tomatoes, pawpaw, avocado and citrus fruits. The total acreage under food crops is about 14,000 ha compared to the total acreage under cash crops of 19'000 ha. The County heavily relies on Agriculture as the source of livelihood for its people and also as the main economic activity.

Livestock farming is gaining popularity with the revival of milk cooperatives and investment by private sector on milk processing plants. Dairy farming is concentrated in the upper parts of the County while in the lower parts indigenous breeds are reared. The main types of animals reared include cattle, goats, sheep and chicken. Rabbit rearing has also become an attractive venture to the farmers.

The main types of fish in the County include; trout, tilapia, mud fish and cat fish which are available mostly in the hydroelectric dams. The government through the Economic Stimulus Program has constructed 200 fish ponds in each of the four constituencies and the fish harvested is usually sold locally. The Ministry of Fisheries Development has not only supervised the construction of fish pond but also supplied fish food and fish fingerlings to the farmers.





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There are four categories of SACCOs in the County namely; Rural, Multipurpose, Urban and Jua kali. In this sub-sector, cooperative societies are being urged to put more emphasis on marketing and value addition of local produce. They improve market access and marketing efficiency in the District. Some of the challenges faced in this sub-sector are financial mismanagement and leadership wrangles.

#### **5.4.2 Trade, Tourism and Industry**

This sector plays a very crucial role in the economic development of the county. The sector generates a lot of income and employment as it absorbs both skilled and unskilled labor. The interface among factors of production in this sector leads to various productive activities yielding many goods and services for consumption within the County and for export to other parts of the country.

Tourism is a key sub-sector that has a high potential in the County for both local and international tourists. Some of the available sites include caves, waterfalls and rocky hills for rock climbers. The County is also a gateway to Mt. Kenya which, if aggressively marketed can bring huge incomes to the County. The County is also a host to a number of hydro-electric power dams which are a source of tourist attraction for both local and international tourists. The major dams that generate hydroelectric power for the Country are partly in Embu County. These dams include Kiambere, Gitaru, Kindaruma and Masinga all of which are situated along the Tana River.

Two National reserves namely; Mwea and Mt. Kenya that are managed by KWS have great potential for the tourism industry in the County. Other potential tourist attractions include the Nthenge Njeru water falls near Kimeri. There are a variety of wildlife species such as elephants, buffaloes, lions, bush bulks, baboons, hippos, colubus monkeys and numerous species of birds.

#### **5.4.2 Physical Infrastructure**

The overall goal of the sector is to have a well developed and maintained physical infrastructure for rapid and sustainable economic growth and poverty reduction. This sector works to facilitate adequate provision of roads and buildings through policy development, providing logistical and technical support in road construction and maintenance, mobilization of resources from both the public and private sectors for construction and maintenance of roads and buildings. The sector also assists in dissemination of research findings and promotion of wide application of innovative materials and technologies. It also develops and maintains both office and residential accommodation of various government departments.



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The roads and public works sub-sector is responsible for development, rehabilitation and maintenance of the road network in the County (classified, urban and rural roads as well as roads in National Parks and reserves). The road network in the county consists of 914.3 Km of earthen surface, 120 km of tarmac which includes the Meru-Embu highway and Embu-Kiritiri road, as well as 548 km of gravel surface. The county is also host to two airstrips. One airstrip is located at Don Bosco in Embu town and is currently being refurbished. It is used mainly for security purposes. The other airstrip is in Kiambere and is mainly used by KenGen.

The energy sub-sector facilitates the provision of clear, affordable, reliable, secure and sustainable energy services for district development. Embu County is a major stakeholder in the energy sector nationally. It is host to the regionally famous seven-folk project which has an installed capacity of 543.2 MW, placing its contribution to the national installed H.E.P capacity at 80.2 percent. In contrast to this rich energy endowment, only 21.2 per cent of households in Runyenjes and Manyatta constituencies are connected to electricity while a mere 4.9 per cent in Mbeere North and Mbeere South constituencies are connected to electricity. The main source of energy is fire wood (80.4 per cent) while electricity coverage is more confined to urban areas as compared to rural areas

#### **5.4.3 Environment, Water and Sanitation**

This sector consists of the water and irrigation; and the environment and mineral resources sub sectors. The water sub-sector promotes and supports integrated water resource management to enhance water availability and accessibility in the County.

Provision of clean and safe water for domestic use and irrigation is important in the county. The county is served by six major rivers; Thuci, Tana, Kii, Rupingazi, Thiba and Ena. The county also shares some major dams, which generate hydroelectric power for the country with Makueni and Kitui Counties. These dams are Kiambere, Gitaru, Kindaruma, Kamburu and Masinga all of which are situated along the Tana River. There is a number of water service providers in the county which include EWASCO, Itabua-Muthatari, Kithimu-Kithegi and Ngandori-Nginda. These water supply schemes supply water to large areas in the County, especially Embu town, Runyenjes area and the larger Mbeere area.

According to the 2009 Population and Housing census, majority of the people in the County use pit latrines for human waste disposal. In Manyatta and Runyenjes constituencies, 2,935 persons used main sewer, 3,676 used septic tanks, 412 used pools, 9,067 used VIP latrine, 63,581 used pit latrines, while 267 used other methods of human waste disposal such as bucket and bush. In Mbeere North and Mbeere South Embu County Integrated Development Plan, 2013-2017 33 constituencies,



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329 persons use main sewer, 400 use septic tanks, 57 use cess pools, 3,173 use VIP latrines, 45,504 used pit latrines, while 2,082 persons used other methods of human waste disposal such as buckets and bush. Of all urban centres in the county, only Embu has a sewage treatment plant that does not have adequate capacity to serve the whole town.

#### **5.4.4 Human Resource Development**

This sector consists of the education; public health; labor and human resource development sub sectors. The overall goal of the education sub-sector is to achieve Education for All (EFA) and Millennium Development Goals (MDG's) by 2015. Embu County is renowned for its numerous learning institutions. As of 2013, there are 450 primary schools serving 125,420 students and 145 secondary schools serving about 27,000 students. The ratio of pupil to teacher in public schools stands at 1:35 while that of student to teacher in public secondary schools is 1:25. Some top schools include Kangaru girls' and Kangaru boys' high schools, Kyeni girls' secondary near Runyenjes, St. Mary Kiangima girls boarding school, Kiambeere school complex, Nguviu boys, Nguviu girls secondary schools among others. Institutions of higher learning include Embu College, Government training Institute (GTI), University of Nairobi, Embu University College formerly E.A.S.T College and Kenyatta University campuses all located within Embu town.

The overall goal of the health sub sector is to provide efficient and high quality health care system that is accessible equitable and affordable for every person in the county. Embu County is well covered with health facilities most of which are dispensaries and private clinics. HIV/AIDS awareness is high in the area but behavioral change is still low and generally the rate of infection is on the rise. The county has 157 health institutions according to the Ministry of Health. Manyatta constituency has the highest number of health institutions at 66 followed by Runyenjes, Mbeere South, and Mbeere North at 41, 26 and 24 respectively. All the health facilities in the area offer VCT services and ARVs are available to all the infected persons in several government facilities.

#### **5.4.5 Research, Innovation and Technology**

There are two major post offices based in Embu and Runyenjes town and 13 sub-post offices in major trading centres. The county is well covered by the 4 mobile network providers namely; Safaricom, Airtel, Yu and Telekom. The county is covered by Local connectivity of a fixed national digital network, an optic fibre cable passing through Embu and Runyenjes towards Meru and also through Kirirtiri to Masinga, but not connected to buildings and other places in the county. There is also a fixed line



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connectivity which is provided by Telkom Kenya system. Data services are provided by Jambonet and Kenya Data Networks while satellite services are offered by Vsat.

**5.6 Public Administration**

The county head quarters and the county treasury are some of the departments that constitute this sector at the county level. The county planning unit is charged with the responsibilities of coordination and supervision of development projects in the county that fall under the national government while the county handles county government projects.. This is achieved through monitoring and evaluating the implementation of development projects by government departments, the Constituency Development Fund and those undertaken by other development partners in the County. The primary goal of this sector is to ensure prudent and effective management of allocated funds and to avoid duplication of development efforts. The local authorities are also tasked with the role of fostering and supplementing the implementation of projects at the grass root levels.

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## CHAPTER SIX

### PUBLIC PARTICIPATION

#### 6.1 Introduction

Consultation with various stakeholders and public participation was done throughout the Environmental Impact Assessment Project Report preparation and compilation. This was in line with the requirements of Legal Notice No. 101, Kenya Gazette Supplement No. 56 of June 13<sup>th</sup> 2003, the Environmental (Impact assessment and Audit) Regulations, 2003. Consultations and public participation was encompassing, interactive and intensive, so as to ensure that as many stakeholders as possible and the public were reached. Special attention was paid to general public especially those drawn from the proposed project site and the immediate neighborhood. Views, comments, concerns and opinions of stakeholders concerning the proposed project were sought. The consultation was vital as it served to:-

- Inform all stakeholders of the proposed development within their locality;
- Explain to the stakeholders the nature of the proposed project, its objectives and scope;
- Give stakeholders a forum to present their views, concerns and issues regarding the proposed development; and
- Obtain suggestion from stakeholders on possible ways that potential negative impacts can be effectively mitigated.

The consultation was in the form of site visits and questionnaire survey

#### 6.2 Site Visits

Visits to the proposed project site were carried out by the team of EIA Experts in the company of project Architect, other consultants and representatives from the county office of Housing and Urban Development. A total of three site visits were done during which, informal discussions were carried out with the people we found along the site and within the proposed project vicinity and occupants of the existing two houses. The EIA team of Experts informally explained to the neighbours and other stakeholders encountered during site visits the proposed project at the proposed project site. The stakeholders encountered presented their views and concerns informally to the team of experts. The experts issued them with questionnaires.

#### 6.3 Questionnaire Survey

A questionnaire survey was carried out in the neighborhood of the proposed project site to obtain views and concerns from stakeholders regarding the proposed development. About 84% of all the



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questionnaires distributed were responded to and returned. The issues and concerns expressed in the questionnaires include the following:-

- Existing trees may be cut/lost.
- Employment for local residents/job opportunities.
- Apart from employment there should be other benefits to the local community.
- Local businesses will access clientele from the construction site.

**6.4 Proposals for improvement**

Some of the proposals raised during the questionnaire survey to boost environmental conservation include:-

- Tree/vegetation coverage on site to be increased.
- Noise pollution during construction to be minimized to acceptable environmental levels.
- Dust during construction to be minimized to acceptable environmental standards.
- There should be no indiscriminate dumping of solid waste.
- Noise absorbent materials to be used to reduce noise.
- Use appropriate personal protective equipments for construction workers such as dust masks.
- Environmental friendly machines and equipments to be used to avoid environmental pollution.
- Water sprinkling to be done to reduce dust.
- Construction work to be limited to daytime.
- Less dusty materials to be used.

**Conclusion:**

The public consultation revealed that the neighbours to the proposed apartments are not opposed to its implementation. The completed copies of the questionnaire are appended herein.



## CHAPTER SEVEN

### POTENTIAL SIGNIFICANT ENVIRONMENTAL IMPACTS:

#### 7.1 DEFINITION & CLASSIFICATION OF ENVIRONMENTAL IMPACTS

An environmental impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts may be positive (beneficial) or negative (adverse). They may also be direct or indirect, long-term or short-term in duration, and wide-spread or local in the extent of their effect. Impacts are termed cumulative when they add incrementally to existing impacts.

In the case of the proposed construction of 220 apartments in Embu town, potential environmental impacts would arise during the construction and the operations phases of the project and at both stages positive and negative impacts would occur.

#### 7.2 IMPACT SIGNIFICANCE

The purpose of an EIA is, *inter alia*, to identify the significant impacts related to the project or activity under consideration and then to determine the appropriate means to avoid or mitigate those which are negative, and if possible, enhance any positive effects resulting from the project.

Significant impacts are defined, not necessarily in order of importance, as being those which:

1. Are subject to legislative control;
2. Relate to protected areas or to historically and culturally important areas;
3. Are of public concern and importance;
4. Are determined as such by technically competent specialists;
5. Trigger subsequent secondary impacts;
6. Elevate the risk to life threatening circumstances; and
7. Affect sensitive environmental factors and parameters.

#### 7.3 IMPACT DESCRIPTION

The following sections discuss the major project activities and the potentially significant impacts related to those activities. For ease of discussion and presentation, the corresponding impact mitigation measures are presented in the next section— section 8

#### 7.4 Potential positive impacts

Positive impacts likely to result from implementation of the proposed project will include:-



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- Creation of jobs;
- Boosting of housing needs thus accommodation for more civil servants working in Embu county;
- Lighting of locality;
- Support of local businesses;
- Infrastructure development; and
- Revenue to government

### **7.4.1 Job opportunities**

Construction sites are a major source of employment opportunities. Although the jobs are not permanent, a considerable number of casuals and contracted people are able to get employment opportunities. The proposed project will create employment opportunities for local youths. This will contribute positively to realization of government target of creating jobs annually.

### **7.4.2 Boosting of housing needs in Embu town**

Just like other cities and towns in Kenya, Embu town is faced with the challenges of increasing demand for housing for civil servants and those working in the private sector in the town. This demand is occasioned by rural urban migration and urban to urban migration. The proposed project will positively contribute to alleviating housing needs in the Embu town

### **7.4.3 Beautification of locality**

The project will result in beautification of the locality. This will include development and widening of local access road and development of storm water drainage. Development of some of these infrastructures will significantly contribute to beautification of the locality.

### **7.4.4 Lighting of locality**

The nature of the project will require improved lighting of the area; the lighting will have to stretch outside the project boundaries. This will improve on local security and overall safety of the area and within the developed property.

### **7.4.5 Support of local businesses**

The proposed project will require the services of different expertise during the implementation stage. This will include contractors and consultants who will be hired to work in different sections of the project. Others will be transporters, suppliers and other services providers to the project will have new business





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opportunity opening as a result of the project. Thus all in the entire project will contribute to support of local businesses.

**7.4.6 Infrastructure development**

Local infrastructure like local roads, storm water drainage, pedestrian walkways within and, telephone, water pipeline, and electricity connectivity will be farther developed to address the needs of the proposed project.

**7.4.7 Revenue to Government**

Once implemented, the proposed project will boost revenue collection for the Embu County Government in form of licenses and permits, farther more government revenue will be remitted to exchequer in form of statutory fees.

**7.5 Construction Phase Negative Impacts**

**7.5.1 Soil erosion – land degradation**

Site preparation, vegetation clearance and excavations using heavy construction equipment usually expose soils in the affected areas and leave them vulnerable to erosion by heavy rainfall and surface run-off. Improper location of stockpiles of sand, gravel, cement, etc., at the construction site could also cause fine materials to be washed into the drainage system during heavy rainfall events. This would not only represent a waste of materials but would also contribute blockage of drainage systems.

**7.5.2 Accumulation of solid waste at the site**

Considerable volumes of solid waste will be generated during site preparation and construction works, which would include some vegetation and typical construction waste such as wasted concrete, steel, wooden scaffolding and forms, pulp and polythene bags, waste earth materials, etc. This waste will negatively impact the aesthetic value of the site and surrounding environments if not properly managed and disposed of at an approved dumpsite. Solid waste, if allowed to accumulate on the ground, could cause localized pooling and flooding. Pooling of water, in turn, would create conditions conducive to the breeding of nuisance and health-threatening vectors such as mosquitoes. Improper management of construction waste constitutes a short-term negative impact.

**7.5.3 Construction works noise – auditory nuisance**

Although not expected to create a significant negative impact, the use of vehicular activities and heavy equipment during construction and building works will inevitably generate noise, which may create a



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nuisance for nearby residents, particularly the immediate neighbours. Albeit annoying, this negative impact will be short-term (limited to the construction phase). Noise beyond some level is itself a nuisance and need to be avoided. Such noise emissions should be minimized as much as possible from the source point through appropriate measures.

**7.5.4 Dust Emission – air quality degradation**

During the construction phase air quality is expected to decline as a result of an increase in levels of fugitive dust from excavation works, the stockpiled earth materials, dusty roads and concrete mixing. Respirable particulates are a public health hazard and may otherwise create considerable nuisances to the public. This is expected to be a short-term, reversible impact lasting only for the duration of the construction activity.

**7.5.5 Spillage of hazardous materials**

All sorts of motorized equipment, from generators to trucks, requiring fuel, lubrication and maintenance will be used at the construction site. Many will also be fitted with lead batteries. Spillage of hazardous materials on the ground surface has a potential of contaminating underground water.

**7.5.6 Fire outbreak – environmental disaster**

Some intensive dry processes will be conducted on site. Such a process may result to a fire outbreak within the project site especially if flammable materials such as locomotive fuel will be stored on site. Minor welding works will be carried out on site so as to repair broken down machines or vehicles and this increases the chances of fire outbreak.

**7.5.7 Construction works induced traffic – traffic congestion**

Activities related to construction works will undoubtedly induce uncharacteristic levels of additional vehicular traffic along Embu-Meru road and the access roads. Related issues of vehicle congestion and reckless driving by truck drivers delivering construction materials to the site will be sources of annoyance, if not accidents, to local residents during the construction phase.

**7.5.8 Construction works water demand – Increased pressure on existing supply**

A considerable amount of fresh water will be required during the construction works, especially for use by construction workers (washing), for cement mixing and for wetting of the site to control dust. This may place some amount of strain on water supply and may exacerbate current shortage of water supply in Nairobi.



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**7.5.9 Gaseous emissions**

The various materials required for construction and building (e.g. sand, ballast, aggregate, steel, blocks, timber, asphalt, cement, etc.) will be obtained from sources within and elsewhere and transported to the site. Transportation of these materials, characteristically in over-laden trucks, usually results to gaseous emissions. Other construction equipment including excavators, bull dozers and concrete mixers have also a potential of resulting to air pollution. Emission of gaseous pollutants into the atmosphere represents indirect, short-term, reversible, negative impacts on public health and safety.

**7.5.10 Disposal of sewage**

Lack of or inadequate provision of toilets for use by workers can lead to ad hoc defecation in secluded areas or structures on the site, thus creating unsanitary conditions and sources of fly infestation. This can threaten the health of neighbours and workers themselves. Indiscriminate sewage disposal can also result to contamination of underground water resources.

**7.5.11 Workers accidents and hazards during construction**

During the construction of these housing projects, it is expected that construction workers are likely to have accidental injuries and hazards as a result of handling hazardous waste. Because of 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.

**7.5.12 Extraction and use of building materials**

Building materials such as hard core, ballast, cement, rough stone and sand required for the construction of the housing project, will be obtained from quarries, hardware shops and sand harvesters who extract such materials from natural resource banks such as river banks and land. Since substantial amount 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 short term. In addition, the sites may be significantly affected in several ways including landscape change, displacement of animals and vegetation, poor visual quality and opening of depressions on the surface leading to several human and animal health impacts.



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**7.6 Operational Phase Negative Impacts**

**7.6.1 Increased pressure on infrastructure**

The proposed 220 apartments will definitely lead to increased pressure on existing infrastructure such as roads, piped water and other utilities like electricity.

**7.6.2 Increased generation of solid waste**

The quantities of solid waste to be generated by the families who will occupy the houses are expected to be significant. Such waste will include foodstuffs, empty plastic containers, cartons, waste papers, plastic bags, etc. Improper management of solid waste will result to aesthetic degradation and breeding of disease vectors.

**7.6.3 Increased traffic flow – Increased accidents**

The number of vehicles within the area is likely to increase and this may lead to congestion and road accidents along main Embu -Meru road and the access Road.

**7.6.4 Effluent Disposal**

A project of such magnitude is expected to generate huge amounts of effluent to the environment. Proper management of the effluent will ensure a clean environment for the residents of this area. The area is served with sewage system and the proponent will connect the sewage from the apartments to the existing one in the area.

**7.7 Decommissioning Phase Negative Impacts**

During the decommissioning phase, another comprehensive EIA study based on the intended new use of the site will be conducted.

**7.7.1 Noise and Vibration – Audible nuisances**

The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding areas. This will be as a result of the noise and vibration that will be experienced as a result of demolishing the proposed project.

**7.7.2 Solid Waste Generation**

Demolition of the apartments 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. 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



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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 ground and surface water quality.

**7.7.3 Dust emission**

Large quantities of dust will be generated during demolition works. This will impact negatively on the demolition staff as well as the neighboring residents.



## CHAPTER EIGHT

### DESCRIPTION OF THE PROPOSED MITIGATION MEASURES

#### 8.1 INTRODUCTION

This section highlights the necessary mitigation measures for the possible negative impacts associated with the construction, operation and decommissioning phases of the proposed project.

#### 8.2 MITIGATION MEASURES FOR IMPACTS ASSOCIATED WITH CONSTRUCTION PHASE

##### 8.2.1 Controlling soil erosion - Loss of topsoil cover

Soil erosion within the project site will be mitigated by applying several measures including;

- Stage site clearance works so as to minimize the area of exposed soil at any given time.
- Re-cover exposed soils with grass and other ground cover as soon as possible.
- Monitor areas of exposed soil during periods of heavy rainfall throughout the construction phase of the project to ensure that any incidents of erosion are quickly controlled.
- Leveling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil
- Building of physical barriers to prevent mass movement where necessary.
- The stockpiling of construction materials should be properly controlled and managed. Fine-grained materials (sand, marl, etc.) should be stockpiled away from any surface drainage channels and features.
- Low bumps should be placed around the piles of sand and marl and/or tarpaulin used to cover open piles of these materials to prevent them from being washed away when it rains heavily.
- Safe storage areas should be identified and retaining structures put in place prior to the arrival
- Materials to be delivered on site in installments.

##### 8.2.2 Management of Construction Waste

Construction waste will be managed by implementing the following measures;

- A site waste management plan should be prepared by the contractor prior to commencement of construction activities. This should include designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site, and a system for supervision and monitoring.



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- Preparation and implementation of the plan must be made the responsibility of the building contractor with the system being monitored independently.
- Special attention should be given to minimizing and reducing the quantities of solid waste produced during site preparation and construction.
- Any Vegetation and combustible waste must not be burned on the site.
- Reusable inorganic waste (e.g. excavated sand/soils) should be stockpiled away from drainage features and used for in filling where necessary and/or possible.
- Unusable construction waste, such as damaged pipes, formwork and other construction material, must be disposed of at an approved dumpsite.
- Provide solid waste receptacles and storage containers, particularly for the disposal of plastic bags, boxes, so as not to block drainage system and to prevent littering of the site.
- Make arrangements for the daily collection of litter from the site and appoint a licensed solid waste transporter to collect and transport it for dumping at approved site.

#### 8.2.3 Control of Construction works noise

Construction works noise shall be controlled by implementing the following measures;

- Restrict noisy construction activities to normal working hours (8am – 5pm).
- Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of piling works.
- Workers operating equipment that generate noise should be equipped with noise protection gear including ear muffs and plugs. Workers operating equipment generating noise levels greater than 85 dBA continuously for 8 hours or more should use earmuffs whereas those experiencing prolonged noise levels of 85 dBA should wear earplugs.
- Limit pick up trucks and other small equipment to an idling time of five minutes, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- All construction equipment should be regularly inspected and serviced

#### 8.2.4 Control of Dust Emissions

The main contractor will be required to train workers on appropriate methods for minimizing dust emission during construction phase. Proposed methods for minimizing dust emission include;

- Covering of all haulage vehicles carrying sand, aggregate and cement



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- Stockpiles of fine materials (e.g. sand and ballast) should be wetted or covered with tarpaulin during windy conditions.
- Access roads and exposed ground must be wetted in a manner and at a frequency that effectively keeps down the dust.
- Workers in dusty areas on the site should be issued with dust masks during dry and windy conditions
- Providing appropriate enclosure for the concrete mixer and
- Use of dust nets at high levels of the building

### **8.2.5 Managing Spillage of Hazardous Materials**

Spillage of hazardous materials shall be managed by implementing the following measures;

- Refueling and maintenance of large vehicles will not take place at the construction site
- All hazardous materials to be stored in appropriately banded containers and placed on concrete floor
- Maintaining spill response kits at the site office
- Prepare and display on site spill response procedures and
- Training of workers on spill response and management

### **8.2.6 Containing Fire outbreak**

Fire incidents shall be managed by implementing the following measures;

- Provide adequate number of appropriate fire fighting equipment
- Post 'No smoking signs' where flammable materials will be stored
- Organize for inspection and maintenance of fire equipment at least once in a period of six months
- Train staff on the use of the available fire fighting equipment
- At least one person trained on handling fire fighting techniques should be available through-out the construction phase of the project.
- Develop and post at the site, fire emergency and evacuation procedures
- Maintain on site telephone contacts for fire brigade, G4S fire brigade and St. Johns ambulance service provider





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**8.2.7 Control of Construction Works Induced Traffic**

Control of traffic build-up during construction phase will be achieved by observing the following measures;

- Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of construction works.
- As far as possible, transport of construction materials should be scheduled for off-peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the roads leading to the site.
- Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the main road in the vicinity of the entrance to the site during the construction period.
- Flagmen should be employed to control traffic and assist construction vehicles as they enter and exit the project site.
- Train drivers on road safety
- Maintain on site a record of incidents and accidents

**8.2.8 Management of Construction works water demand**

The proposed development will increase water demand throughout the construction phase. Increase in water demand can be minimized by;

- Providing adequate water storage reservoirs at the construction site to meet project needs during periods of high demand externally and refill the tanks during periods of low demand (e.g. late at night).
- Engaging water supply tankers in case of total supply failure.
- Implementing appropriate water conservation measures

**8.2.9 Management of terrestrial habitat & biodiversity**

Biodiversity at the proposed site shall be managed by retaining and restoring as much of the original vegetation, including trees, as is practical on the site. This would be achieved by:

- Set a replanting and landscaping programme that focuses on increasing “green area”
- Ensure proper demarcation of the project area to be affected by the construction works. This will be aimed at ensuring that any disturbance to flora is restricted to the actual project area and avoid spill over effects on the neighboring areas.



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- In the same vein, there will be strict control of construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works.

#### **8.2.10 Management of Sewage**

Sewage will be managed by;

- Providing adequate sanitary facilities for workers, e.g. portable chemical toilets with appropriate sanitary arrangement, to prevent increased bacterial loading to runoff.
- Sensitize workers on the rationale of using the sanitary facilities.
- The area being sewered appropriate sanitary facilities should be provided for construction staff.

#### **8.2.11 Control of gaseous emissions**

Gaseous emissions will be managed by;

- Proper engine tune up
- Regular inspection and maintenance of construction equipment
- Reducing idling time
- Avoiding burning of solid waste at the site

#### **8.2.12 Workers Health & Safety**

Due to the intensive masonry works, workers will be exposed to risks of accidents and injuries.

The contractor is therefore expected to ensure safety of his workers by;

- Engaging only those workers that are trained to operate specific machines and equipment.
- Proper signage on site to warn workers of safety requirements as regards machines with moving parts and other equipment at site.
- Provide a First Aid box and have a trained person to handle site emergencies and incidences. Display in the site telephone numbers of ambulances or provide a site vehicle to specifically transport the injured to hospital.
- Provide fire-fighting mechanism at site. Display emergency call numbers that can be used in case of a site fire.
- Provide safe scaffoldings and railings at heights.
- Provide washing (enclosed bathroom) and toilet facilities at site with both drinking and washing water. The number of workers engaged determines the number of the toilets and bathrooms provided.



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- Providing safety helmets, safety masks (welders), safety shoes (loaders), uniforms and hand gloves to the workers.
- Using well-maintained equipment by qualified personnel.

## **8.3 PROPOSED MITIGATION MEASURES FOR OPERATIONAL PHASE IMPACTS**

### **8.3.1 Reducing pressure on infrastructure**

Relevant authorities such as the Kenya Power and Lighting other utility providers have been informed of the capacity of expansion and are aware of the necessary requirements concerning the project. However, the proponent will install water-conserving automatic taps and toilets, as well as energy saving electrical fittings to optimize use of public resources. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by a licensed plumber. In addition, the occupants of the apartments will be sensitized to use conserve energy and water. It will be important for the proponent to monitor water and energy use during the operation phase of project and to set targets for their efficient use.

### **8.3.2 Proper solid waste management**

The occupants will be responsible for proper management of solid waste generated from their units during operation phase. In this regard, they are required to engage the county government to collect waste or contract a private waste handler who is licensed by NEMA for waste disposal.

### **8.3.3 Control of traffic flow**

The proponent will be required to implement the following measures in order to control flow of traffic during operational phase.

- Appropriate traffic warning signs instructing occupants and visitors to reduce speed, should be placed at the vicinity of the entrance to the site
- Security guards should be instructed to control traffic along the private road leading to the site and assist vehicles as they enter and exit the project site.
- Security guards should maintain a record of incidents and accidents at the site
- Emergency response procedures shall be developed and displayed at the entrance to the buildings
- Contacts of emergency service providers including St. Johns ambulance, breakdown vehicle and traffic police, should be displayed at the main entrance area

### **8.3.4 Management of Fire Incidents**

Fire incidents shall be managed by implementing the following measures;



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- Install fire fighting equipment prior to occupation of the buildings
- Ensure fire fighting equipment are inspected and serviced at least once in a period of one year
- Identify and mark conspicuously an emergency assembling point
- Conduct an annual fire audit for the buildings

### **8.3.5 Effluent disposal**

Effluent from the apartments will be disposed through the existing sewer line.

## **8.4 MITIGATION MEASURES FOR DECOMMISSIONING PHASE IMPACTS**

### **8.4.1 Proper solid waste management**

Demolition waste will be managed by implementing the following measures;

- A site waste management plan should be prepared by the contractor prior to commencement of demolition activities. This should include designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site, and a system for supervision and monitoring.
- Any Vegetation and combustible waste must not be burned on the site.
- Demolition debris should be stock piled at a safe place
- Reusable materials like doors, windows and timber should be sold to licensed scrap dealers
- Provide solid waste receptacles and storage containers, particularly for the disposal of plastic bags, boxes, so as not to block drainage system and to prevent littering of the site.
- Make arrangements for the daily collection of litter and demolition debris from the site by a licensed solid waste transporter for dumping at approved site.

### **8.4.2 Control of dust emission**

High levels of dust concentration resulting from demolition or dismantling works will be minimized by implementing the following measures;

- Covering of all haulage vehicles carrying debris for dumping at approved sites
- Stockpiles of fine materials should be wetted or covered with tarpaulin during windy conditions.
- Access roads and exposed ground must be wetted in a manner and at a frequency that effectively keeps down the dust.
- Workers in dusty areas on the site should be issued with dust masks and safety goggles
- Proper hording (fencing with three meter high galvanized iron sheets) of the site prior to demolition



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**8.4.3 Minimization of noise and vibration**

Significant impacts on the acoustic environment will be mitigated as described below;

- Restrict demolition activities to normal working hours (8am – 5pm).
- Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of demolition works.
- Workers operating equipment that generate noise should be equipped with noise protection gear including ear muffs and plugs. Workers operating equipment generating noise levels greater than 80 dBA continuously for 8 hours or more should use earmuffs whereas those experiencing prolonged noise levels of 70 – 80 dBA should wear earplugs.
- Limit pick up trucks and other small equipment to an idling time of five minutes, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- All demolition equipment should be regularly inspected and service.



## CHAPTER NINE

### OCCUPATIONAL HEALTH AND SAFETY

#### 9.1 Introduction

Occupational Health and Safety (OHS) is of paramount importance at construction sites. It is important for mechanisms to be put in place to predict potential risks, incidents and hazards in the said working environment. This is because the occupational environment directly affects employees involved in construction, the neighbourhood, visitors, contractors, sub-contractors and the general public. Therefore before commissioning the construction, a number of safety measures have to be in place to ensure the safety of employees, neighbours and the general public. Employees and visitors to the construction site may be exposed to a variety of personal health and safety risks. The type and level of exposure is generally related to factors controlled by the employer/ developer. Such factors include design, equipment, tools, work procedures, construction materials, and employee training. Occupational health and safety risks that must be considered by the employer arise from normal functions and operations and during unusual circumstances such as accidents and incidents.

The Ministry and the site contractor will be responsible for OHS requirements at the proposed construction site:

- Implementation of appropriate national and internal recognized OHS standards, codes and guidelines;
- Inclusion of meaningful participation of employees in implementation and maintenance of procedures and processes;
- Implementation of a programme to change employee involved in construction culture and attitudes regarding health and safety;
- Planning, implementing and monitoring programs and systems required to ensure OHS at the workplace;
- Provide and maintain workplaces, equipment, tools and machinery and organize work so as to eliminate or control hazardous ambient work factors;
- Provide appropriate occupational health and safety training for all employees;
- Provide adequate personal protective equipments to all employees at no cost to employees;
- Record and report occupational injuries and illness to the Directorate of Occupational Safety and Health (DOSH);



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- Ensure contract specifications include demands for service providers, contractors, and sub-contractors to have or establish systems enabling them to meet the OHS requirements of the employer.

#### **9.2 Occupational Health and Safety Management System**

The Ministry and the site contractor to establish manage and operate an Occupational Health and Safety Management System (OHSMS) for the proposed construction of the 53 apartment units. The OHSMS must contain the following features:

1. Occupational Health and Safety Policy;
2. Organizational framework of the OHSMS;
  - ✓ Staffing of OHSMS;
  - ✓ Competence requirements;
  - ✓ Operating procedures;
  - ✓ Training programs;
  - ✓ System documentation;
  - ✓ Communication.
3. OHSMS objective (documentation)
4. Hazard prevention
  - ✓ Risk assessment;
  - ✓ Prevention and control measures (active and negative);
  - ✓ Management of changes;
  - ✓ Emergency preparedness and response;
  - ✓ Procurement (tools, equipment, services, contractors).
5. Performance monitoring and measurements
  - ✓ Hazard prevention measures;
  - ✓ Ambient working environment;
  - ✓ Work related injuries, ill health, disease and injuries.
6. Evaluation
  - ✓ Feedback;
  - ✓ Corrective measures;
  - ✓ Action plan.



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**9.3 Employee safety**

In addressing requirements and needs to ensure employee safety, the following should be in place by the site contractor: -

- ✓ Provision of adequate personal protective clothing,
- ✓ Enforcement and proper use of personal protective clothing by all employees;
- ✓ Provision of first aid and emergency services on site;
- ✓ In case of injury of employee during work; management must have a clear policy on treatment of the injured employee;
- ✓ In case of permanent disability arising from injury at work place, adequate compensation should be available;
- ✓ Appropriate tools and equipment in sound working condition must be provided to employees to enable them work safely; and
- ✓ All practical measures must be in place to ensure that the work place is free of dust and excessive noise.

**9.4 Safety of neighbours and general public**

Construction sites are associated with incidents and accidents that endanger neighbours and general public. The contractor on site at the proposed apartment units must ensure the safety of all neighbours and the general public is taken care of by putting the following measures in place:-

- ✓ All neighbours must be informed of the date of commencement of construction at least two weeks in advance in writing;
- ✓ Sealing off the entire construction site from access by unauthorised person;
- ✓ Construction work should be limited to day time to avoid unduly disturbance to neighbours at night;
- ✓ Heavy vehicles and truck ferrying materials to construction site must observe required minimum speed limit when approaching the site to avoid accidents;
- ✓ There should be notices and warning prominently displayed at entry of construction site and around perimeter fence informing general public of ongoing activity and safety requirements;
- ✓ Placing notices and safety slogans at strategic points to inform and educate neighbours and the general public; and
- ✓ There should be 24-hour guard of the site.





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**9.5 Machine Use and Electrical Safety**

During construction work, it is expected that different machines, tools and equipment such as dumpers, cement mixers, elevators, and excavators will be used. Most of this equipment will be powered internally by use of diesel. In regard to electrical safety, the following will have to be undertaken: -

- ✓ Installation and fitting of proper electrical system to enable supply of electrical energy to utility point;
- ✓ All electrical installations and fittings are done according to electrical safety rules;
- ✓ All electrical wires must be safely insulated;
- ✓ Sockets and other electrical outlets must be securely fitted;
- ✓ When not in use all machines should be put off;
- ✓ Qualified and well-experienced electrician should be hired to carry out all electrical work;
- ✓ Safety slogans should be strategically posted as a reminder to employees;
- ✓ All machine operating manuals should be available for use whenever needed;
- ✓ Each machine operator should be conversant with the use of the machine operating manuals.

**9.6 Internal Safety Matters**

Once the apartment units are complete and ready for use safety of the occupants should be taken care of. Internal safety needs will need to be addressed right from the construction phase through to operational phase. Some of the things that need to be in place include; -

**9.7 Emergency Preparedness**

The structure, design and orientation of the 53 apartment units should be in such a way that it takes care of emergency needs. The following must be incorporated:

- ✓ There must be sufficient emergency exits;
- ✓ Each emergency exit must always be clear of any obstruction;
- ✓ Each emergency exit must be clearly marked;
- ✓ There should be an elaborate fire fighting system in place with the following fire fighting equipments, potable fire extinguishers, fire hydrants, foam, fire blanket, fire alarm, smoke detectors;
- ✓ A fire evacuation procedure should be in place in case of a fire. The procedure should be available to all users of the facility who must familiarize themselves with it;
- ✓ There should be a designated fire assembly point which must be clearly marked;
- ✓ There should be sufficient reserves of water for fire fighting; and



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- ✓ Once in awhile fire drills should be conducted.

### **9.8 Staircases**

There will be a need to ensure that internal safety measures for staircases are in place. This includes;

- ✓ All staircases must be soundly constructed;
- ✓ A lump must be provided alongside staircases for physically challenged occupants;
- ✓ Staircases and the lump must not be slippery.

### **9.9 First-Aid**

- The site contractor to ensure first aid services are provided to employees at all times;
- An appropriately equipped First-Aid station to be easily accessible at the construction site;
- An eye-wash station and/or emergency shower shall be provided where the recommended first-aid response is immediate flushing with water;
- The First Aid station to be equipped with gloves, gowns and masks for protection against direct contact with blood and other body fluids;
- A written Emergency Procedure to be in place.

### **9.10 Personal Protective Equipment**

- Contractor to identify and provide appropriate Personal Protective Equipment (PPE) such as safety boots, hard helmets, hard gloves, ear muffs and nose and mouth masks, that will offer adequate protection to the workers and occasional visitors without incurring unnecessary inconveniences;
- The contractor to actively enforce use of PPE;
- The contractor to ensure PPE are cleaned when dirty, properly maintained and replaced when damaged or worn out; and
- Proper use of PPE to be part of recurrent training programmes for employees.

### **9.11 Ambient factors in the construction site**

#### **Noise**

- Noise levels at the construction site should be within the prescribed limits in the first schedule of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009;
- Employees not to be exposed to noise levels greater than 85dB(A) for a duration of more than 8 hours per day;



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- No unprotected ear to be exposed to peak sound pressure level (instantaneously) of more than 140 dBC; and
- The use of ear protectors must be actively enforced.

**Dust**

- Exposure to dust to be controlled by ensuring dust accumulation at workplace is controlled;
- Equipment to be selected, especially that with in-built dust extraction system;
- Employee exposed to dust to be provide with disposable dust masks.



**CHAPTER TEN**

**ENVIRONMENTAL MANAGEMENT PLAN**

Expected negative impacts	Recommended mitigation measures	Responsibility party	Cost	Time frame
Increased solid waste	<p>Use of integrated solid waste management of options i.e. source reduction, recycling, composting and re-use, combustion and sanitary land filling</p> <p>Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed</p> <p>Dispose waste more responsibly by dumping at designated dumping sites</p> <p>Waste collection bins to be provided at designated points on site</p> <p>Reuse packaging materials such as cartons, cement bags, empty metals and plastic containers to reduce waste at the site</p> <p>Use construction materials containing recycled content when possible and in accordance with accepted standards</p> <p>Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste</p> <p>Use of durable, long-lasting materials that will not need to be replaced as often</p> <p>Provide facilities for proper storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements</p>	Proponent	300,000/-	Once/throughout construction period
Dust emission	<p>Avoid excavation works in extremely dry weather</p> <p>Ensure strict enforcement of on-site speed limit regulations</p> <p>Covering of all haulage vehicles carrying sand, aggregate and cement</p> <p>Stockpiles of fine materials (e.g. sand and ballast) should be wetted or covered with tarpaulin during windy conditions.</p> <p>Access roads and exposed ground must be wetted in a manner and at a frequency that effectively keeps down the dust.</p> <p>Workers in dusty areas on the site should be issued with dust masks during dry and windy conditions</p>	Proponent	100,000	Throughout construction period



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	<p>Providing appropriate enclosure for the concrete mixer and</p> <p>Use of dust nets at high levels of the building</p>			
Noise vibrations	<p>Sensitize construction drivers to avoid running of vehicles engines or hooting especially when passing through sensitive areas such as church, schools or hospitals</p> <p>Ensure the construction machinery are well kept in good condition</p> <p>Sensitize construction drivers and machinery operators to switch off engines when not being used</p> <p>Trees to be planted on site to provide some buffer against noise propagation</p> <p>Ensure all generators and heavy machines are insulated or placed in an enclosure to minimize ambient noise levels</p> <p>Restrict noisy construction activities to normal working hours (8am – 5pm).</p> <p>Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement of piling works.</p> <p>Workers operating equipment that generate noise should be equipped with noise protection gear including ear muffs and plugs. Workers operating equipment generating noise levels greater than 80 dBA continuously for 8 hours or more should use earmuffs whereas those experiencing prolonged noise levels of 70 – 80 dBA should wear earplugs.</p> <p>Limit pick up trucks and other small equipment to an idling time of five minutes, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.</p> <p>All construction equipment should be regularly inspected and serviced</p>	Proponent	70,000	Throughout construction period
Oil/hazardous materials spills	<p>A designated garage section of the site fitted with oil trapping equipments to be planned for changes. Such area will protect the soil from contamination.</p> <p>Refueling and maintenance of large vehicles will not take place at the construction site</p>	Proponent	100, 000	Continuous



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	<p>All hazardous materials to be stored in appropriately banded containers and placed on concrete floor</p> <p>Maintaining spill response kits at the site office</p> <p>Prepare and display on site spill response procedures and</p> <p>Training of workers on spill response and management</p>			
Safety and security	<p>Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site</p>	Proponent	200,000	Continuous till end of construction
Hydrology and water quality degradation	<p>Hazardous substance control and emergency response plan that will include preparations for quick and safe clean up of accidental spill</p> <p>Hazardous-materials handling procedures to reduce the potential for a spill during construction to be prescribed</p> <p>Identify areas where refueling and vehicle maintenance activities and storage of hazardous materials, if any, will be permitted</p>	Proponent	50,000	Continuous
Generation of wastewater	<p>Provide means for handling sewage generated by construction workers i.e. construction of pit latrines on the site since this area does not have sewage system</p> <p>Ensure the latrines are clean</p>	Proponent	Minimum	Throughout construction period
Occupational healthy and safety risks	<p>Train workers on use of machines and simple maintenance.</p> <p>Provision of fire fighting mechanism</p> <p>Sensitization campaign on STDS and AIDS in the workers</p> <p>Monitoring solid and effluent disposal</p> <p>Proper signage on site to warn workers of safety requirements as regards machines with moving parts and other equipment at site.</p> <p>Provide a First Aid box and have a trained person to handle site emergencies and incidences. Display in the site telephone numbers of ambulances or provide a site vehicle to specifically transport the injured to hospital.</p> <p>Provide fire-fighting mechanism at site. Display emergency call numbers that can be used in case of a site fire.</p>	Proponent	100,000 p.a	Once/continuous



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	<p>Provide safe scaffoldings and railings at heights.</p> <p>Provide washing (enclosed bathroom) and toilet facilities at site with both drinking and washing water. The number of workers engaged determines the number of the toilets and bathrooms provided.</p> <p>Providing safety helmets, safety masks (welders), safety shoes (loaders), uniforms and hand gloves to the workers.</p>			
Soil erosion and storm water/runoff	<p>Ensure that any compacted areas are ripped to reduce run-off</p> <p>Site excavation works to be planned such that a section is completed and rehabilitated before another section begins</p> <p>Ensure that the construction vehicles are restricted to graded roads to avoid soil compaction within the project site.</p> <p>Apply soil erosion control measures such as leveling the project site to reduce runoff velocity and increased storm water into the soil.</p> <p>Construction of pavements</p> <p>Planting of grass</p> <p>Lining of storm water drains with Pcc slabs and invert drains</p> <p>Designing of a storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of retention with graduated outlet control structure.</p>	Proponent	20,000 p.a	Continuous
Fire control	<p>Installation of fire extinguishers at strategic points e.g. stores.</p> <p>Have maintenance contract with suppliers and records of inspection kept.</p> <p>Display warning signs e.g. "Danger" "NO SMOKING" prominently within the construction site especially in parts where inflammable substances are stored.</p> <p>Train workers on emergence procedures</p>	Proponent	30,000 p.a	Continuous
Traffic control	<p>Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of construction works.</p> <p>As far as possible, transport of construction materials should be scheduled for off-peak traffic hours.</p>	Proponent	Minimal	Throughout construction time



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	<p>Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the main road in the vicinity of the entrance to the site during the construction period.</p> <p>Flagmen should be employed to control traffic and assist construction vehicles as they enter and exit the project site.</p> <p>Maintain on site a record of incidents and accidents</p>			
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Environmental management and monitoring plan during the operation phase

Impacts expected	Recommended mitigation measures	Responsibility party	Cost	Time frame
Solid waste generation	<p>Ensure solid generated at the house units are regularly disposed of appropriately at authorized dumping areas</p> <p>Use of integrated solid waste management of options i.e. source reduction, recycling, composting and re-use, combustion and sanitary land filling</p> <p>Ensure the occupants of the units manage their wastes effectively</p> <p>A private company to be contracted to collect and dispose solid waste on regular basis</p>	Occupants	8,000per month	Continuous
Release of sewage to the environment	<p>Use of the existing sewer line for effluent disposal</p> <p>Apply for the license to NEMA for effluent disposal</p> <p>Conduct regular inspection for the system to ensure it works effectively</p>	Occupants	1000 per inspection	Continuous
High demand for water	<p>Create water conservation awareness</p> <p>Install a discharge meter at water outlets to determine and monitor total water usage</p> <p>Ensure water taps are not running when not in use</p> <p>Residents to conserve water e.g. by avoiding unnecessary toilet flushing</p> <p>Promptly detect and repair of water pipes and tank leaks</p>	Occupants	5000 per month	Continuous



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Security	Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premise	Residents	15,000 per month	Continuous	
Fire control	Fire extinguisher to be placed strategic positions Escape routes to be provided Servicing of fire extinguishers as is necessary. Always inspect electricity wires	occupants	20,000 annually	Continuous	
High demand for electricity	Switch off electrical appliances and lights when not in use Install occupational sensing lights at various locations such as storage areas which are not in use all the time Install energy saving fluorescent tubes Monitor energy use during the operation of the project and set targets for efficient use Sensitize housing units occupants to use energy efficiently	occupants	2000 per month	Continuous	
<b>DECOMMISSIONING STAGE</b>					
Environmental issues	Effect of operations had on environment	Conduct an EIA study and prepare detailed decommissioning plan	Proponents of the houses	Market value at that time	At the end of the project life
	Implementation of work	Set up a team to foresee decommissioning work	Proponent	Market value at that time	



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**MONITORING PROTOCOLS DURING CONSTRUCTION**

Monitoring Issue	Parameter	Monitoring Method	Indicator	Frequency of Measurement/Assessment	Responsibility
Air Emissions/ Ambient Air quality	Dust	Visual Inspection	Airborne particles	Continuous	Main contractor
	Engine exhaust smoke	Ditto	Colour of exhaust smoke	Ditto	Main Contractor
Noise	Noise Level	Time averaged measurements in dB (A) at the site	Complaints from the neighbours	Continuous	Main Contractor
Waste Management	Amount of Solid waste produced	Tracking the volume of solid waste generated and establishing the storage, transport and disposal methods	Waste streams and volumes generated on site	Continuous	Main contractor
	Hazardous Waste	Tracking all hazardous waste and establishing storage, handling and disposal methods	Generated quantities of: <ul style="list-style-type: none"> <li>• Used oil</li> <li>• Waste paints</li> </ul>	Continuous	Main contractor

Monitoring Issue	Parameter	Monitoring Method	Indicator	Frequency of Measurement/Assessment	Responsibility
Health and Safety	Occupational Health and Safety monitoring	Reporting of accident and incidents, safety breaches and damage to equipment	Statistical records and safety reports	Continuous	Main contractor



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**After Construction (Operation Phase)**

<b>Monitoring Issue</b>	<b>Parameter</b>	<b>Monitoring Method</b>	<b>Indicator</b>	<b>Frequency of Measurement</b>	<b>Responsibility</b>
Water Quality	Effluent discharged to the existing sewer line	Samples for laboratory analysis	Complaints	3-Monthly	Caretaker
Waste Management	Solid waste	Tracking the volume of solid waste generated and establishing the treatment, storage, transport and disposal methods	Waste streams and volumes generated	Continuous	Caretaker /occupants
Health and Safety	Occupational Health and Safety monitoring	Reporting of accident and incidents, safety breaches and damage to equipment	Statistical records and safety reports	Continuous	Ditto
	Efficient use of resources	Consumption records of water, electricity and other resources	Financial savings in subsequent bills	Monthly	Ditto/occupants

**CHAPTER ELEVEN**

**CONCLUSIONS AND RECOMENDATIONS**

The result of this EIA study report has indicated that there are no significant and permanent negative impacts likely to be generated by the construction of the said residential apartments. Most of the potential negative impacts to be generated have been considered as low and can only cause 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 quality of the environment at said site and to the community in the surrounding areas.

The EIA experts recommend that the proposed project be approved subject to the implementation of the proposed environmental management plan to avoid environmental and health surprises during construction and occupancy of the apartments.



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**APPENDICES**

Title deed

Questionnaires

Architectural designs