ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED PHASE 1 OF WILLOW PARK HOMES ON L.R. NO. KIAMBAA/THIMBIGUA/2116, KIAMBU COUNTY

NEMA/PR/5/2/10,773

JUNE 2013

In Accordance With

Environmental Management and Coordination Act (EMCA), 1999, EIA/EA Regulations 2003

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ACKNOWLEDMENT

Earthcare Services Limited takes this opportunity to thank Northside Developers Limited for providing a chance to conduct this Environmental Impact Assessment (EIA) Study Report of the proposed Willow Park Homes along Banana-Raini Road in Banana Hill. This was done in an endeavor to comply with the Legal requirement as stipulated in section 58 of the Environmental Management and Co-ordination Act (EMCA) of 1999 legal Notice No.8.Sincere thanks to our client for availing the necessary documentation and facilitating the site visits to enable the experts to effectively carry out the EIA.

EXECUTIVE SUMMARY

1.0 Introduction

The project proponent (Northside Developers Limited) has proposed to develop Phase 1 of residential dwelling units by the name Willow Park Homes which will consist of 10 apartment blocks adding up to a total of 148 apartment units on a 17.88 acre piece of land **LR No. Kiambaa/Thimbigua/2116** in Banana Hill, Kiambaa Constituency, Kiambu County. The 10 apartment blocks will be of 5 types:-

- Block type A (4 storey)
- Block type B (4 storey)
- Block type C (2 storey)
- Block type D (2 storey)
- Block type E (2 storey)

Initially the proponent had proposed to develop 20 apartment blocks and 49 town houses but the initial architectural designs were revised and the current ones for phase 1 have been approved by the Local Authority.

The Project proponent has endeavored to ensure that the proposed development project and other associated infrastructural undergo an EIA Full Study following a project report to ensure that significant impacts on the environment are taken into consideration at the design, construction and operation stages of the project. It is against this background that this study report was commissioned. Below is a summary of the anticipated significant impacts and their proposed mitigation measures.

Figure 1: Summary of anticipated impacts and possible mitigation measures

Anticipated Impacts	Mitigation measures
Noise pollution	• Provision of barriers such as walls around the site boundaries to provide some buffer against noise • Installation of portable barriers to shield compressors and other small stationary equipment where necessary • Put up signs to indicate construction activities • Maintain all equipments • Silenced machinery and instruments should be employed • Equipment such as drills, graders and cement mixers should also be used when the least number of residents can be expected to be affected • Workers working with machinery, vehicles and instruments that emit high

Anticipated Impacts	Mitigation measures
	levels of noise should be provided with ear plugs and ear muffs • Sensitize workforce including drivers of construction vehicles
Air pollution/ particulate matter (dust)	• Stockpiles of earth should be sprayed with water or covered during dry seasons. • Buffer area of trees and other vegetation will serve as natural windbreaks •Provide PPE such as nose masks to the workers in dust generation areas. • All raw materials must be sourced as close as possible to the construction site thus reducing the emissions from vehicular traffic. • Machines must not be left idling for unnecessary periods of time. • Vehicle speeds in the construction area will be limited to minimize dust in the area • The construction contractor will water the site with exposed soil surfaces twice daily during dry seasons • Avoid pouring dust materials from elevated areas to ground • Cover all trucks hauling soil, sand and other loose materials • Provide dust screen where necessary
Increased solid waste	• The contractor and proponent should work hand in hand with private refuse handlers and Karuri Town Council to facilitate waste handling and disposal from site. The resulting debris will be collected, transported and disposed off at suitably approved dumpsites • The materials should be properly segregated to encourage recycling of some wastes. Demolished stones can be used as backfills
Loss of biodiversity	•After project completion, proponent should rehabilitate the site by planting local trees, grass and ornamental flowers at all disturbed areas • Remove as little vegetation throughout the site as possible • Retain vegetation screens to reduce the visual effect of this stage of the development • Maintain all mature trees (trees > 25 cm) within the development; • The developer should incorporate trees that are used by bird species for foraging to attract bird species to the area.
Soil erosion	• Control earthworks

Anticipated Impacts	Mitigation measures
	• Provide soil conservation structures on areas prone to soil erosion to reduce impact by run-off • Control construction activities especially during rainy seasons • Ensure that the drainage plan proposed is implemented as stipulated on the plan. • The provision of a system of culverts should be considered. •Conduct landscaping after project completion to maximally control any possible chance of soil movement. •The proponent will maintain a 15m buffer zone so as to protect the riparian ecosystem of Kaaruchi River
Water sources	• Management of water usage. Avoid unnecessary wastage of water • Avail storage tanks. • Roof catchments should be provided with water harvesting systems to enhance collection & storage of rain water • Store all raw materials away from the vicinity of water bodies. • General refuse generated during these phases of the development must be stockpiled in one central area of the development site, away from existing water bodies. • Clearance of vegetation must be avoided in periods of heavy rainfall to reduce the impact of runoff. • Install siltation traps within the drainage design to collect silt and sediments ensuring that they do not end up in adjacent aquatic areas. • Conduct periodical water quality monitoring to ensure that standards are maintained.
Sewage & effluent	•Routine checkups of and monitoring of the WWTP to avoid leakages and blockages •Construction of a WWTP to be done to meet the standards by Karuri Town Council
Public health and occupational safety	•Adequate sanitary facilities should be provided and standard cleanliness maintained • Ensure proper solid waste disposal and collection facilities

Anticipated Impacts	Mitigation measures
	• Proper handling and disposal of solid waste • Provide suitable safety gear for all personnel • Proper treatment of waste water • Construction activities must therefore be limited between 0800hrs and 1700hrs • First aid kit to be provided on site and ensure that a crew member is trained in basic first aid practices. • Signs must also be placed around the construction site displaying the numbers of the person responsible for handling emergencies on the site •Contractor should have workmen's compensation cover which should comply with workmen's compensation Act
Road safety	• Road signs on main roads • Enforce speed limits for construction vehicles • Implement a traffic system that involves appropriate signals and signs to ensure the smooth flow of traffic • Perform road repair and construction at times that persons are expected to be at work and school
Socio economic concerns	• Develop a Corporate Social Responsibility programme which could provide assistance to the community. • Persons from the nearby communities should be employed to work on the construction site. • Purchase sullies to be used in the construction should be sourced from nearby suppliers • Implement HIV/AIDS and other communicable diseases programmes in conjunction with relevant ministries • Where possible offer women equal opportunities as men

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ACRONYMS AND ABBREVIATIONS

EHS	Environmental Health and Safety
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
KPLC	Kenya Power and Lighting Company
NEMA	National Environment Management Authority
NEAP	National Environmental Action Plan
OHS	Occupational Health and Safety
PPE	Personal Protective Equipment
TOR	Terms of Reference
WRMA	Water Resources Management Authority
WWTP	Waste Water Treatment Plant

CHAPTER 1

1.0 INTRODUCTION

1.1 Definition of Analytical terms and threshold

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.

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).

***Neutral Impact*:** A change which does not affect the quality of the environment.

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

Significant impact: An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

Profound impact: An impact which obliterates sensitive characteristics.

'***Do-Nothing Impact'***: The environment as it would be in the future should no development of any kind be carried out.

Indeterminable Impact: When the full consequences of a change in the environment cannot be described.

Irreversible Impact: When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.

Residual Impact: The degree of environmental change that will occur after the proposed mitigation measures have taken effect.

Synergistic Impact: Where the resultant impact is of greater significance than the sum of its constituents.

'***Worst Case' Impact:*** The impacts arising from a development in the case where mitigation measures substantially fail.

Cumulative impacts: are identified as impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions

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.

1.1.1 Environmental Thresholds

Finding of Significant Impact: the screening and scoping process establishes that the project has negative impacts on environment and therefore should be subjected to further study

Negative determination: the project does not cause any negative impact on the environment; it the project has only positive impacts

Negative determination with conditions: the project causes negative impacts on the environment but they can be effectively mitigated through implementation of the environmental management plan

Positive Determination: the project causes adverse impacts on the environment and as such it should be redesigned or subjected to further scrutiny.

1.2 Project background

Earthcare Services Limited has been commissioned by Northside Developers Limited to carry out a comprehensive full study Environmental Impact Assessment for the proposed Willow Park Homes to be developed on a piece of land along Banana – Raini Road about 200m from Banana Hill Center, Kiambu County. This comprehensive study is meant to address any possible negative impacts and environment-related conflicts that may result from different phases of the proposed project. This will in the long term ensure not only a safe and clean environment, but also ensure that the proposed development activities are in conformity with the existing environmental rules and regulations.

1.3 Terms of reference

The following Terms of Reference apply to the project:

i) Hold appropriate meetings with the project proponent to establish the procedures, define requirements, responsibilities and a time frame.

ii) Produce an EIA study report that contains among other issues potential negative and positive impacts and recommendation of appropriate mitigation measures to minimize or prevent adverse impacts

iii) Carry out a systematic environmental assessment at the proposed project site and the surrounding area.

iv) Provide a description of the proposed activities throughout the entire implementation process of the project with a special focus on potential impacts to the surrounding environment and facilities.

v) Develop an Environmental Management Plan, a Social Impact Assessment Plan (SIAMP) and cost estimates for the proposed project

1.4 Justification of the proposed project

Increase in population and urbanization in Nairobi has led to rapid increase in demand for residential houses which has led to people moving out of town and staying in the satellite centers within the vicinity of the city or staying in shanties. The acute environmental problems associated with the informal settlements cannot be overemphasized.

Banana Hill area is also home to a number of education, industrial and health institutions that require accommodation for their staff members. The housing needs of these people can only be taken care of through construction of facilities like the proposed one. More importantly, it is vital to optimally utilize the land especially now that the land mass in Nairobi area's rapidly dwindling.

There are also similar projects within the area which have been operational without significant negative impacts to the environment and the neighbouring populations. This land use is in harmony with the land use class of the area.

The project will lead to economic empowerment not only of the project proponent but also of a host of other people who will both directly and indirectly benefit from jobs and business opportunities resulting from the presence of the project within the neighbourhood.

Revenue generation to the central government through land rates and taxes as a result of the implementation of this project will lead to the much needed economic development.

In terms of environmental degradation, the project is likely to lead to very minimal negative impacts, which shall be easily taken care of in the design and the proposed mitigation measures have been suggested in chapter 8 of this study report.

1.5 Project Objectives

- To provide quality apartments for sale which are currently in demand
- To provide the government revenue through the remittance of taxes
- To meet economic desires of the proponent
- To put the current land into more productive and economic use

1.6 Objectives of the study

Compliance with the Environmental Management and Coordination Act (EMCA) 1999, which establishes a requirement for environmental impact assessment (EIA) study for a project such as this

that is out of character with the surroundings, in order to establish the potential positive and negative impacts of the project to the integrity of the environment forms the basis of this study. The broad objective of undertaking this full Environmental Impacts Assessment study was to identify significant potential impacts of the proposed project to the environment and social aspects and formulate recommendations to ensure the project takes into consideration appropriate measures to mitigate any adverse impacts to the environment in all phases of its implementation.

The key objectives of this study include the following:

(i) To identify and evaluate the significant environmental impacts of the proposed project.

(ii) To determine the compatibility of the proposed facility with the neighbouring land uses and evaluate local environmental conditions.

(iii) To access and analyze the environmental costs and benefits associated with the proposed project

(iv) To evaluate and select the best project alternative from the various options available

(v) To incorporate environmental management plans and monitoring mechanisms during implementation and operation phases of the project

1.7 Methodology

The methodology used in the study consisted of the following:

- A site reconnaissance and visual survey to determine the baseline information of the project area
- Comparative study of the project with existing land uses in the neighborhood.
- Analysis of the project documents
- Discussion with the proponent
- Assessment of the site to detail the various existing and likely impacts.
- Assessment of health and safety issues
- Seeking public views through public meetings with relevant stakeholders, interviews and questionnaires.
- Proposal of mitigation measures to minimize any negative impacts.
- Preparation and submission of the study report

CHAPTER 2

PROJECT DESCRIPTION

2.1 Project Proponent

The project proponent is Northside Developers Limited of P.O. Box 102, Karuri.

2.3 The location of the project

The proposed project will be located in Banana hill area along Banana-Raini road approximately 6km off Limuru road from Ruaka Town. The project site lies adjacent to the tarmac road on coordinates -1.17S, 36.75E. The proposed site neighbors mainly other individual houses and residential estates e.g. Jumbo Court & Platinum Estate.

2.6 Site ownership, Zoning & Land Use

2.3 Site Ownership

The proposed site is Land Reference Number Kiambaa/Thimbigua/2116 which measures approximately 17.88 acres and will be used to develop the proposed development. The parcel of land is registered in the name of the proponent. (*Copy of Title deed attached at appendix).*

The proposed site is within an area formerly zoned for agricultural use and the proponent has an approval for change of user from Agricultural to Multi-residential dwelling units (*change of user permit attached at appendix*). The architectural drawings have already approved by the Local Authority.

2.7 Project description and design

The proposed Phase 1 of Willow Park Homes has been designed such as to ensure maximum comfort and safety of the occupants of the buildings. As per the architectural designs, the development will consist of 10 apartment blocks of 5 types adding up to a total of 148 units:-

- Block type A (4 storey 2&3 bedroom apartments)
- Block type B (4 storey building. Ground, first, second and third floors floor will comprise of 2&3 bedroom apartments while the attic floor will consist of four 1 bedroom apartments)
- Block type C (2 storey 4 bedroom apartments on each floor)
- Block type D (2 storey 3 bedroom apartments on each floor)

- Block type E (2 storey 4 bedroom apartments on each floor and a laundry room on the ground floor comprising of a receiving unit, washing unit, manager's office, storage area, kiosk and 3 washrooms)

The above information is as per the architectural designs.

Basically, each apartment unit will be composed of:

- ✓ Spacious Lounge cum dining area
- ✓ spacious bedrooms with master en-suite
- ✓ Modern spacious fully fitted kitchen
- ✓ Built in wardrobes
- ✓ Natural stone to wall
- ✓ Concrete roofing tiles
- ✓ Ceramic tiles to all floors
- ✓ Painted steel casement windows
- ✓ Reliable water supply with adequate water storage tank for each unit/apartment block
- ✓ Centralized main gate and stone perimeter wall for security
- ✓ Paved estate road and drive way
- ✓ A spacious car parking space

A mechanical waste water treatment plant will also be installed by Ecomaji Company on the adjacent piece of land L.R. No. Kiambaa/Thimbigua/2117 which is legally owned by the proponent.

During operation, water will be sourced from a borehole which will be drilled after the proponent acquires an abstraction permit from WRMA and an EIA to be also conducted.

2.8 Design criteria

A preliminary investigation will be undertaken to determine the topography, ground water table level, nature and characteristics of the soil and bearing capacities. The results will determine the nature of the structural forms that will be adopted with regards to foundations. The structural design criteria will depend on the structure. The type of sewerage disposal system and storm water drainage system adopted will also be influenced by the results of the preliminary investigation. All the designs will comply with the applicable codes of practice. The foundations will also be governed by the results from the geotechnical investigation. The sewerage disposal system proposed will be that of a

mechanical sewerage treatment system to enable recycling of the waste water in the estate which can be used for irrigating the gardens and cleaning purposes.

The design criteria and characteristics of the proposed Willow Park Homes will also include the following among others:

- All works to be carried out in accordance with the local authority's regulations – Karuri Town Council
- All drainage passing under building and drive areas to be of PVC pipes.
- All sanitary work to be in accordance with MOH rules and regulations and Karuri Town Council requirements
- All reinforced concrete (RC) works to be to structure engineer's details

2.9 Construction activities and inputs

All the construction inputs shall be obtained from licensed dealers. The following will be required for successful implementation of construction activities:

- Construction tools and equipment including machinery mainly transportation vehicles will be used for the transportation of materials and in the execution of the proposed works.
- A construction labour force of both skilled and non skilled workers
- Water for construction purposes

2.9.1 Input during construction

Typical inputs which will be used in construction phase are, Land, Water to be obtained from Karuri Water and Sanitation Company. The materials that shall be used include building sand, aggregates, natural stones, hand cut construction stones, timber for making structural formwork and interior design, tiles for roofing and floor tiles. Others include concrete block for constructing selected internal and external pavements, precast units for drains, PVC pipes for sewer and water reticulation, paints, electrical wiring and fitting, barbed wires, wire mesh, water tanks and aluminum gutters. Window casement and glasses, spades, pick axes, and other hand held tools will also be needed.

2.9.2 Construction activities and timetable.

The construction activities shall begin from the time NEMA gives approval of the EIA Study report. The construction activities shall begin with excavation of soil and rocks from the site. Materials from the excavations of the ground and foundation work will be reused for earth works and landscaping.

The site will then be filled with hardcore and murram then be compacted as other civil and engineering works shall follow.

2.9.3 Project implementation sequencing

i. Pre-construction stage

This involved the following:

a) Plan preparation and seeking of the appropriate approvals from the relevant authorities.

b) Appraisal of baseline condition to determine supply and demand for required infrastructural services.

c) EIA Project Report and Study report preparation.

ii. Construction stage

This will involve the following:

a) Establishment of related works and all support infrastructures that are significant for the construction work.

This would involve the transportation of machinery and deployment of the workers to the construction site. The machinery would be used for ground breaking and transportation of materials from the sources to the site. The major machineries that will be used include mixers, welding machines and transmission machines. The contractor will also mobilize human workforce casual, permanent, skilled and unskilled.

b) Acquisition and transportation of building materials.

The contractor shall source for materials for construction from the various available suppliers. Supply of materials will be a continuous activity throughout the project life since different materials will be needed at different phases of the construction. The materials that shall be used in the construction include among others building stones, sand, ballast, cement, timber, reinforced concrete frame, steel, bars, G.I pipes, PVC pipes, pavement blocks, concrete slabs, murram, hardcore, insulated electrical cables and timber among others.

c) Construction of the apartments

The engineering designs and site layout plans that have been approved shall be implemented. The setting will comply with the specifications set out by the client to the contractor under the supervision of qualified engineers. In accordance with the designs and the layout plans, the construction of the proposed project and associated infrastructure will begin immediately NEMA approves the study report. The contractor will then be supplied with all the approved documents including the EIA study report.

d) Excavation and land filling works

Excavation will be carried out to prepare the site for construction of foundations, pavements and drainage systems. This will involve the use of heavy earthmoving machinery such as tractors and bulldozers.

e) Masonry, Concrete Work and Related Activities

The construction of the building walls, foundations, floors, pavements, drainage systems among other components of the project will involve a lot of masonry work and related activities. General masonry and related activities will include stone shaping, concrete mixing, plastering, slab construction, construction of foundations, and erection of building walls and curing of fresh concrete surfaces. These activities are known to be labor intensive and will be supplemented by machinery such as concrete mixers.

f) Structural Steel Works

The buildings will be reinforced with structural steel for stability. Structural steel works will involve steel cutting, welding and erection.

g) Roofing and Sheet Metal Works

Roofing activities will include sheet metal cutting, raising the roofing materials such as concrete roofing tiles and structural timber to the roof and fastening the roofing materials to the roof.

h) Transportation of the construction wastes from the site for landscaping.

Construction waste that cannot be used for landscaping work at the site will be deposited in approved dumpsites by a contracted licensed waste handler.

i) Electrical Work

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

Power distribution

The position of transformer is allocated along Banana-Raini Road. A preliminary load schedule indicates that the project will increase power demand and it is proposed that the proponent should consider other power sources to reduce on the power demand. The proposals include solar power especially for water heating purposes. A standby generator is another option considered by the design team to supplement power supply when experiencing power outage problems.

j) Plumbing

Installation of pipe work for water supply and distribution will be carried out within the apartments and associated facilities. In addition, pipe work will be done to connect sewage from the premises to the waste water treatment plant, and for drainage of storm water. Plumbing activities will include metal and plastic cutting, the use of adhesives, metal grinding and wall drilling among others.

k) Fire protection

Self-contained fire detection and alarm system complete with manual call points, optical smoke detectors, heat detectors and electronic sounders will be proposed especially in the kitchen area.

A hose reel fire protection system will be provided to cover the buildings. The system will comprise of a water storage tank, distribution of pipe work and fire hose reels and portable fire extinguishers will be provided at convenient spots. Additional provision will be made for special hazards and high-risk areas

l) Landscaping

To improve the aesthetic value or visual quality of the site once construction ceases, the Proponent will carry out landscaping. This will include establishment of flower gardens and lush grass lawns and will involve replenishment of the top soil. It is noteworthy that the proponent will use plant species that are available locally preferably indigenous ones for landscaping.

2.9.4 Activities during Occupation stage

This stage shall involve running and managing the facility as per the laid down rules and procedures.

a) Residential activities

Once construction is complete, the houses will be ready for occupation by the interested buyers.

b) Solid waste and waste water management

The proponent will provide facilities for handling solid waste generated within the facility. These will include dust bins/skips for temporarily holding waste within the premises before final disposal by the contracted licensed waste handler at the designated dumping site.

Sewage generated from the residential buildings will be discharged into the wastewater treatment plant, while the storm water drainage system will also consist of a network of Inverted Block Drains, manholes and road gullies which will discharge to a suitable outfall.

c) Cleaning

The proponent will be responsible for regular washing and cleaning of the pavements. Cleaning operations will involve the use of substantial amounts of water, disinfectants and detergents.

d) General Repairs and Maintenance

The residential buildings will be repaired and maintained regularly during the operational phase of the project. Such activities will include repair of building walls and floors, repairs and maintenance of electrical gadgets and equipment, repairs of leaking water pipes, painting, maintenance of the gardens and grass lawns and replacement of worn out materials among others.

2.9.5 Decommissioning Phase

Decommissioning of operations is here taken to mean that the buildings cease to operate and the premises are closed down or reverted to another use. Under such circumstance, the occupants/buyers will be expected to adhere to the legislation applicable to such undertaking in the laws of Kenya but in general the decommissioning shall be staggered through a number of steps and measures to rehabilitate the site to its status before the commencement of the buildings occupancy or to a suitable state for its next use. This will involve looking for alternative uses for the site that is compatible to the surrounding and to the former use. An environmental impact assessment shall be commissioned to advice on the environmental aspects with respect to the identified new use if found necessary. If no other use(s) are found for the site, rehabilitation measures to revert it to its former use a state shall be implemented that include:-

i) Building stones, paving slabs, and other installations of economic use can be sold-off in the market through a biding or auction sale.

ii) Dug up areas such as the boreholes should be backfilled with uncontaminated earth.

iii) All solid wastes including debris shall be disposed in a designated dumpsite.

iv) The site shall be re-vegetated with vegetation capable of protecting the soil from erosion

The owners will then, deregister its operations and legal requirements such as the certificates of operations will be surrendered to the relevant issuing bodies

2.10 Wastes

There will be liquid, solid and gaseous wastes from the project site. These will be from project activities during construction, operation and decommissioning phases. There shall be wastewater from civil works, workers and the storm water.

It is envisaged that at the construction stage, wastewater that shall be discharged will also be sprinkled on work areas to reduce dust generation by construction machinery. Other wastes from construction site will be mainly material residues of the construction material. These include pieces

of concrete, heaps of sand and aggregates, bits and pieces of various pipe types, cans of paint, polythene sheets, paper packing materials, pieces of timber, pieces of iron (metals) among others scattered within the project site. All debris and garbage generated during all stages of the development will be placed in a central place on the project site and collected by a licensed garbage disposal company who will deposit an approved disposal site.

Wastes during operation will include used papers, kitchen waste, plastic wrappings, boxes, empty bottles and effluent from toilet flushing, among others. It is expected that the liquid waste shall be managed through connection to the MYFAST 4.0 wastewater treatment plant. During operational phase, the residents shall contract a private waste handler to dispose of their household waste after an agreed time interval.

Wastes from decommissioning of the project will include salvaged equipment; water tanks, windows, doors and other demolished stone blocks among others.

2.11 Air emissions

Relative air emission is expected during construction when dust from demolition/ construction activities and smoke from construction machinery will be emitted. It is recommended that

Watering the site especially during dry periods be enforced to keep dust at minimal levels. The employees at the site especially during construction activities shall be provided with dust masks to protect them from dust and fumes associated with construction activities.

2.12 Waste management

The principle objective of waste management program is to minimize the pollution of the environment as well as to utilize the waste as a resource. This goal should be achieved in a way that is environmentally and financially sustainable.

2.13 Solid waste management

The technologies for the management of the solid wastes will incorporate the collection of the waste from the source, transportation of the waste to the place of storage and final disposal through a contracted waste handler. The following waste management techniques shall be used in the different stages of the project.

a) During construction.

The main wastes from the construction site will consist of material residues of the construction materials. These include pieces of concrete, heaps of sand and aggregate, bits and pieces of various

pipe types, cans of paint, polythene sheets, paper packaging materials, pieces of timber, and off cuts of metals among others. They shall be managed as follows:

- Express condition shall be put in the contract that before the contractor is issued with a completion certificate; he will clear the site of all debris and restore it to a state acceptable by the supervising architect and environmental consultant.
- Materials from excavation of the ground and foundation works shall be reused for earthworks and landscaping.

b) During operation

During operation phase, residents will contract a licensed waste handler who will collect their household waste at agreed intervals and dump them at licensed waste dumping sites.

2.14 Effluent treatment

During construction stage, wastewater that shall be discharged shall be sprinkled on the working areas to reduce dust generation by the construction machinery.

Wastewater during operational stage shall be managed through connection to the wastewater treatment plant which shall be installed at the adjacent site. Recycled water shall be treated to recommended standards and utilized for gardening, flushing, car wash, fire suppression and general external works.

2.14.1 Waste water treatment plant

A mechanical wastewater treatment plant (MYFAST 4.0 bioreactor) shall be put up by Ecomaji Company to treat effluent biologically through a process known as “extended aeration” or “aerobic digestion” (drawings attached).

In this process of treatment, the incoming wastewater enters an aeration tank where the contents are thoroughly mixed and aerated by large volumes of air which are pumped into the tank under pressure. Aerobic bacteria present in the activated sludge in the tank use oxygen which was transferred to the liquid tank to convert the wastewater to inoffensive, clear, odorless liquids and gases. FAST systems are biological, as a result the treated water will require disinfection prior to reuse unless the preferred method of discharge is subsurface. Ecomaji prefers the use of chlorine tablets introduced via a tablet feeder. Gravity based tablet feeders require little input and no maintenance. In addition, Chlorine in the right doses can achieve 100% disinfection. The residual chlorine left in the reservoir tank will further pass to irrigation lines, which in the long run is beneficial in preventing bacterial re-growth. FAST treatment systems operate on the principal of

1litre=1litre out. MyFast Bioreactors: Aerobic system yields 20-20 (BOD, TSS) results. Therefore, the water quality is suitable for discharge into the environment.

Recycling for irrigation would require the water to be pumped from the collection tank at the treatment site possibly to a high level tank which can then feed the grounds with treated water via gravity.

The effluent from the Wastewater Treatment plant will be fit for other uses such as; washing cars, irrigation, flushing toilets, grounds cleaning and fire suppression. In wet seasons when the daily requirements for the treated water are reduced, the excess can be discharged to the storm drain or alternatively excess may be discharged in the nearby Kaaruchi River. This will require some dechlorination.

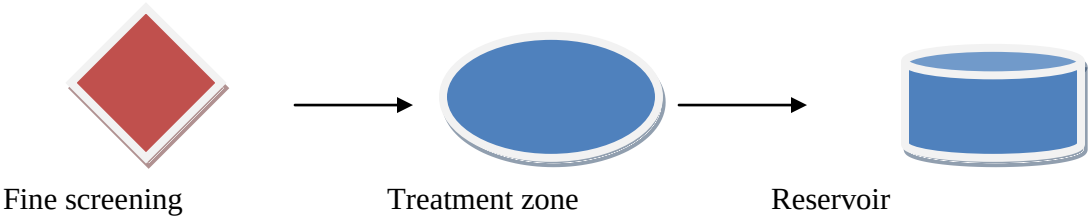

Figure 2 ***Waste water treatment process (Source: Ecomaji)***

The waste water treatment systems will meets the standard set by Karuri Town Council, department of Public Health and NEMA specifications.

Project budget

The project budget is approximately Ksh. 729,896,254.00

CHAPTER 3

3.0 STUDY AREA

3.1 Location

The project area is in Banana Hill which is a suburb of Karuri town, in the eastern part of Kiambu County, Central Province of Kenya. The town situated 2,000 m above sea level, approximately 20 km north of Nairobi City via Limuru Road by Runda Estate. It is approachable from an alternate route, the Limuru, Kiambaa/Kiambu and Ndenderu/Redhill all-weather roads, accessed by the main Limuru road. The proposed project is located along Banana-Raini road approximately 6km off Limuru road from Ruaka Town. The project site lies adjacent to the tarmac road on coordinates -1.17 S, 36.75 E

3.2 Topography

Kiambu County is divided into four broad topographical zones: Upper Highland, Lower highland, Upper midland and Lower midland.

The upper midland zone (UH0 and UH1) is found in Lari constituency, 1800 meters above sea level (masl). Soils are highly fertile, very deep, well drained, dark reddish brown to dark brown, strongly calcareous and in many places, saline / sodic with lava fields present. The upper part of Lari is more of a forest reserve and water catchment area than an agricultural zone, though farmers raise livestock (sheep), engage in dairying and grow various crops and temperate fruits. Rainfall is reliable.

The lower Highland zone (LH1-LH2) is mostly found in Limuru and parts of Githunguri and Kikuyu constituencies at 1500-1800 masl. Soils are well drained, shallow, dark reddish brown and moderately fertile. The main farming system is tea-dairy, though maize, pyrethrum, horticultural crops, fruits and sheep farming are also found.

The Upper Midland zone (UM2-UM6) is located at latitudes of less than 1500 masl and occurs in all constituencies except Lari. Soils are dark reddish brown, well drained, deep and have acidic humic topsoil.

The Lower Midland zone (LH3-LH5) is found in parts of Kikuyu and Limuru constituencies. Soils are dissected erosional plains and vary from well drained, shallow and dark red to yellowish red, stony loamy sand to imperfectly drained, very deep, dark brown and strongly calcareous soils with a sodic clay topsoil. This area is dry since rainfall is low and unreliable. Main crops are maize, sorghum and millet. Farmers keep livestock.

The project area is situated at 2000 masl.

3.3 Climate

The climate in Kiambu County is largely influenced by altitude. The area receives an average annual rainfall of 790 mm (31 in) with average temperatures ranging from 48° to 84°F in January and 45° to 79°F in July. Rainfall is bimodal. Long rains occur between April and May, followed by a cool season during July and August, culminating in short rains between October and November. Rainfall distribution is reliable and has largely influenced agricultural activities in the County. Most mornings and evenings are chilly.

3.4 Geology and soils

Kiambu has three broad categories of soils namely high level uplands soils, soils on the volcanic foot ridges and plutonic soils. These Nitisols and Andosols are generally well-developed, well-drained, deep, and high in fertility and are suitable for cultivation of various crops. However, repeated and high intensive use has led to depletion of soil nutrients. The plutonic soils found in the semi-arid areas of the County are either sandy or clay soils that are poorly drained but have potential for ranching and cultivation of drought resistant varieties.

3.5 Drainage

The drainage pattern in the locality is generally towards east.

3.6 Water resource

The surface water and sub-surface water resources in the county are abundant. There are a number of permanent rivers (16), springs, wells and boreholes. Reliability of these water sources is very high as most of the rivers and water facilities are perennial. A substantial percentage of households in the County also harness rain water through roof catchment. Similarly, underground water resources are greatly exploited and boreholes drilled have high yields with good potential for irrigation, except in the semi-arid lowland divisions of Ndeiya and Karai.

The locality is connected to an established water system supply; Karuri Water and Sanitation Company Ltd. Kaaruchi River which is a tributary of Nairobi River borders the project site and the proponent will maintain a 15m buffer zone so as to protect the riparian ecosystem. The water used at the site during construction will be obtained from Karuri Water and Sanitation Company.

3.7 Vegetation

The proposed site is within an area formerly zoned for agricultural use hence the site is dominated mainly by food crops like tomatoes, kales, beans, maize with fruit trees like mangoes and avocadoes since it's currently being used for agriculture. Exotic grass and trees are along the riparian buffer zone; the rest of the land that has not been cleared for farming is dominated by exotic grass. The proposed project site is situated in an area where man through cutting trees and clearing has modified the original vegetation to create more space for farming and settlements.

3.8 Socio Economic Environment

3.8.1 Land Use

Kiambu is a predominantly agricultural County with nearly 70% of the population engaged in cultivation. Most farms (90%) are smallholder although few large-scale holdings exist in the County. The food cropping patterns are dominated by production of maize, beans and potatoes, mostly in mixed intensive cultivation with maize production registering average yields of about 72 kg per ha. Tea, coffee and horticultural products (flowers, cabbage and potatoes) are the main income earners. While in the past coffee and tea have formed the major cash generating activities, there has been some little shift to livestock and high value horticultural enterprises in the recent years due to a ready urban market in Nairobi, Kiambu town, and the international market for flowers. The high population pressure has resulted in high fragmentation of land, thus decreasing the average land holdings to about 0.8 ha which necessitates intensive cultivation. An increasing number of farmers are migrating to more marginal land in the neighbouring areas where traditional agricultural techniques are less appropriate.

Banana Hill is located in the temperate Kenyan Highlands and was so-named by British Colonial soldiers, locally known as *johnnies*, who could only see banana plantations as they looked downhill towards the capital city, Nairobi, whenever they drove their military trucks over the hills en route to Limuru. The green scenery has now been rapidly been replaced with mushroomed red rooftops of mansions as the city of Nairobi spread north.

3.8.2 Economy

Kiambu is a predominantly agricultural County with nearly 70% of the population engaged in cultivation. However, the farming sub-sector is yet to achieve its full potential owing to constraints

such as use of uncertified seeds, shortage and high costs of farm inputs, lack of appropriate storage facilities, poor farming skills and drought in the semi-arid parts of the County.

The County has witnessed a rise in livestock production with the main enterprises being dairy cattle, poultry and pig keeping, in that order. The local food processing industries and proximity to a ready market in Nairobi has increased the demand for livestock products. The County's
Industrial sector is fairly robust owing to demand from and proximity to the capital city of Nairobi and it has flourishing milk processing and packaging industries, among others. Prospects for industrialization remain high in the dairy sector and manufacture of animal feeds. Though there are a good number of financial institutions operating in the county, the demand for financial services by the hardworking and enterprising population is enormous and expansion and further capacity building is needed.

3.8.3 Communication network

The project area is well served with communication network. This has a strong implication on the socio- economic development activities. The project area is also well served with electricity, water and telephone services. Mobile phone services like YU, Orange, Safaricom and Airtel are present in the area. Karuri Post office also serves the area.

3.8.4 Road Network

Kiambu County boasts a relatively well-developed physical infrastructure with nearly half of its total 1,167.4 Km of classified road length tarmacked and adequately maintained. The project area is served by a good road network that is tarmacked.

3.8.5 Energy sources and conservation

The project area gets the bulk of its energy supply from the Kenya Power and Lighting Company (KPLC).

3.8.6 Health.

The project area is accessible to numerous public and private health facilities that can help residents in case of medical emergencies. There are health facilities that are within the immediate vicinity of the project area such as Karuri Health Centre which is one of the oldest medical centres in the

country. It provides outpatient services to area residents, has an 18-bed capacity; and offers maternity services.

3.8.7 Education

There are numerous schools in the area;

- **Primary (elementary) schools** in the area include Karuri Primary School; Kiambaa Primary School; Msingi Bora Academy; Muthurwa Primary School; Thimbigwa Primary School and others.
- **Secondary (high) schools** include Karuri High School; Muthurwa High School; Senior Chief Koinange High School, and off Banana-Kiambu Road in Kiambaa, Kiambu County—Banana Hill High School, a private secondary school which offers French language coursework.
- A nearby **postsecondary school** is Banana Hill Technical Training Institute, in Karuri town.

3.8.8 Religion

Most of the residents of this county are Christians. The oldest churches of the Banana Hill area were based on Protestant (primarily Anglican) and Catholic faiths. The major churches of Banana Hill are St. Martin de Porres Catholic Church Karuri; and member churches of the ACK (Anglican Church of Kenya), such as ACK Emmanuel Church Karuri, ACK Thimbigwa Church, and ACK Banana Hill Church. Within the recent past, many other churches of different denominations have sprung up.

CHAPTER 4

4.0 PROJECT ALTERNATIVES

4.1 Introduction

This section examines alternatives to construction of these residential developments in terms of the site, products, materials, technology and waste management. Also, impacts of each alternative are identified, discussed and compared with those of this development proposal. With such information, reviewers have basis for decision making.

4.2 No Project Alternative.

This option implies that the existing situation prevail i.e. no construction/development activity to take place. This option is mostly applicable in situations where the proposed project area is in ecologically sensitive areas. The land in which the building is to be constructed is in a stable environment and therefore will not be affected by this development activity. From a socio-economic perspective the "no action" alternative may not be the best alternative as the numerous benefits to be gained from the development both locally and nationally would not be realized and the resources in the area would continue to be underutilized since the land lies idle. The 'No Project Option' is the least preferred from the socio-economic and partly environmental perspective since if the project is not done: -

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

From the analysis above, it becomes apparent that the 'No Project Alternative' is not the appropriate alternative to the local people, Kenyans, and the Government of Kenya. This alternative describes a situation where the proposed development fails to be implemented. In case this happens, positive impacts associated with the proposed development will not accrue to the stakeholders including the residents to be, the development consultants, contractors and suppliers of materials. However, from an environmental conservation perspective, this alternative will be beneficial in the sense that any potential negative impacts associated with the project will be avoided. The "No Action Alternative"

should not be adopted, as we need to encourage development so long as it is undertaken on a sustainable basis as per the environmental management plan developed in this report. In addition, adopting the no action alternative will mean that the existing shortfall in housing needs will continue to prevail unabated. This is not viable since the proponent had already committed finances and land to a development project that suits development objectives. Construction of these houses will create employment to most of the youths in Banana Hill area. If the project is stopped then the trickle-down of financial resources will not be felt in this area. In this respect, the "No project alternative" is not deemed appropriate.

4.3 Proposed Project alternative

The development area for the proposed Willow Park Homes will see some changes to its environmental attributes (physical and biological). Ecologically there will be loss of habitat and species diversity in the area. While not discounting the value of the ecology that persists in the area, the loss to be incurred will be significant but not major as the species diversity in the area is not very high. Moreover the proponent plans to retain most of the ecological sensitive areas. Drainage patterns, groundwater, surface water and soil quality may also be affected. From a Socio-Economic perspective the proposed development would contribute significantly to a partial national, regional and local income generation. In addition numerous jobs would be created by the development either directly or indirectly as well as community growth and development for the surrounding communities.

4.4 Alternatives to Site

Currently, there is no other alternative site available to the proponent for the proposed development. Looking for the land to accommodate the scale and size of the project and completing official transaction on it may take a long period. In addition, it is not a guarantee that such land would be available. The project design and planning before the stage of implementation would call for cost; already incurred in the proposed development i.e. whatever has been done and paid to date would be counted as a loss to the proponent. Assuming the project will be given a positive response after (say relocation) by the relevant Authorities including NEMA, it (project) would have been delayed for a long period before implementation. The other consequence of this is that it would discourage both foreign and local investors especially in the building sector. In consideration of the above concerns and assessment of the current proposed site, relocation is not a viable option.

4.5 Construction Materials and Technology

There is a wide range of construction and furnishing materials which can be sourced locally and internationally. In this construction, certified raw materials/equipments and modern technology will be used. Also, electrical appliances that save energy will be given first priority. The concrete walls will be made using locally sourced stones, cement, sand (washed and clean), metal bars and fittings that meet the Kenya Bureau of Standards requirements.

4.6 Solid Waste Management Alternatives

Throughout construction, the project will produce wastes such as soil, wood chips, metal scraps and paper wrappings among other. Wastes to be generated during operation phase are mainly domestic in nature. The Proponent is expected to observe EMCA (Waste Management Regulations, 2006). Priority will be given to reduction of wastes, recycling, and reuse. This will minimize environmental pollution.

CHAPTER 5

5.0 PUBLIC CONSULTATION

5.1 Introduction

Public participation is basically concerned with involving, informing and consulting the public in planning, management and other decision-making activities. Public participation tries to ensure that due consideration is given to public values, concerns and preferences when decisions are made. It encompasses the public actively sharing in the decisions that government and other agencies make in their search for solutions to issues of public interest.

Public consultation in this project was done with the following aims:

- To inform the neighbors and other stakeholders about the proposed project and its objectives
- To seek views, concerns and opinions of people in the area concerning the project
- To establish if the local people foresee any positive or negative environmental effects from the project and if so, how they would wish the perceived impacts to be addressed.

5.2 Methodology

Public participation was mainly achieved through direct interviews, observations and questionnaire administration. Traditionally the tool used to collect information is the administration of open ended questionnaires where the respondent is free to comment on issues at own thinking. After individuals complete the questionnaires individually and the expert finds some divergent and conflicting responses, usually Focus Group Discussions are held only on the conflicting ideas for the respondents to discuss the contentious issues and come to an agreement by themselves after informing each other. Scoping entailed identification of key stakeholders (stakeholders comments attached at appendix) and subsequent use of a questionnaire (Appendix) and a major focus group discussion (FGD) to gather information on concerns regarding the project from stakeholders. Some of the neighbours participated in the FGD. For the study reported here interviews were conducted individually on a preset open ended questionnaire to collect the views of various stakeholders. Respondents were selected among the communities surrounding the site of the proposed development. All the stakeholders accepted to respond but some answered with a few words. Most of those consulted however, were happy to fill the questionnaire freely. The following is a detailed discussion of public consultation methodology used by the EIA team.

5.2.1 Direct Interviews

Direct interviews were used to get responses from the project proponent whose comments were sought through engaging him in discussions about the proposed project and other related issues.

5.2.2 Questionnaire administration

Questionnaires were uniformly distributed to the neighbouring residents. The neighbours were informed of the proposed project and requested of their views concerning the project. They were used to capture their views in terms of the positive and negative impacts that they anticipate the project and the mitigation measures. They were also requested to provide information about the areas, focusing on aspects such as sensitive ecosystems, cultural sites, and important species in the area amongst other issues. (Some of the questionnaires issued are attached at appendix)

5.3 Stakeholders comments

It emerged from the stakeholders' consultation that the project is welcome in the area as they do not anticipate any negative impacts from its construction and operation. (Stakeholders comments sheet attached at appendix)

5.4 Major Socio-economic Concerns Raised

The neighbors expressed their gratitude to the parties involved in the process since to them this was a new development unlike before when no proponent consulted them, hence they participated actively in raising their concerns and it is their hope that right lawful procedures will be taken into consideration.

Dilapidation of Existing Infrastructure

Concern was also raised that the construction works may lead to the dilapidation of existing infrastructure especially the existing roads due to the use of heavy vehicles such as bulldozers and construction trucks. It was suggested that the proponent should take responsibility for any such happenings and should be prepared to make the necessary repairs during the construction phase and when the construction work is complete.

Creation of Employment

Some participants cited past experiences where the locals are paid less than others. The project proponent responded by mentioning that the contractors will be hired on promise that they will consider local people when hiring.

5.5 Major Environmental Concerns Raised

Noise and Vibration

There was concern over the possibility of high noise and vibration levels especially after 5:00pm in the project site as a result of construction works. The sources of noise pollution will include transport vehicles, construction machinery and metal grinding and cutting equipment. However, the proponent assured them that construction will start from 8:00am – 5:00pm and will take appropriate steps to minimize noise impacts including provision of appropriate protective equipment to construction workers, planning and minimizing the frequency of materials transport and ensuring that all equipment are well maintained.

High Water Demand

The respondents feared that the increase of human population in the area may lead to strain on the existing water resources in the area and dwindling of the same. There was need for the proponent to ensure that additional and alternative water sources are available.

Dust Generation

The people expressed concern over possibility of generation of large amount of dust within the project site and surrounding areas as a result of transportation of building materials. The proponent will ensure that dust levels at the site are minimized through sprinkling water in areas being excavated and along the tracks used by the transport trucks within the site. Additional mitigation measures presented in the EMP will be fully implemented to minimize the impacts of dust generation.

Transport Trucks

Concern was raised over the heavy transport trucks that will be turning around the project site while delivering construction materials. In addition, to contribution of noise and emission of exhaust fumes around the premises, such trucks may slow down traffic flow. The proponent will put in place measures to address such concerns by ensuring that construction vehicles preferably deliver materials during off-peak hours when traffic volume is low. In addition, the mitigation measures outlined in the EMP will be fully to address environmental issues relating to construction trucks.

Aesthetics

It was seen that the aesthetics of the area would be affected negatively during construction. It was suggested that the proponent should ensure high hygiene standards within the premise and surrounding areas during construction possibly by landscaping. More so via the prescribed EMP, the proponent shall put in place several measures aimed at ensuring high standards of hygiene during commissioning within the project site and surrounding areas.

Waste Disposal

Waste disposal is an alarming case that they felt the project should address in order not to pollute the environment. In conjunction to this they felt accumulation of solid waste could pollute the land.

CHAPTER 6

6.0 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

There are a number of policy and legal provisions that have direct bearing on the optimum operation of the proposed development. They include the following:

6.1 Relevant national policies

The following national policies are of relevance to the proposed project

6.1.1 The National Environmental Action Plan (NEAP)

The NEAP was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and conservation of natural resources are an integral part of societal decision making.

Relevance to the proposed project

The NEAP has indicated how resources within particular sections of the country should be managed in order to ensure their sustainable utilization. The project should be implemented and operated based on these guidelines

6.1.2 Environment and development policy (Sessional Paper No.6 of 1999)

The aim of this policy is to harmonize environmental and development goals so as to ensure sustainability. The paper provides comprehensive guidelines and strategies for government action regarding environment and development.

Relevance to the proposed project

The interaction of the proposed project with physical elements may lead to some negative impacts. Mitigation measures are therefore necessary to ensure balanced coexistence of the project and the surrounding environment and facilities

6.2 Legal framework

6.2.1 Environment Management and Coordination Act, 1999

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

undertaking specified in the Second Schedule to this Act, submit a project report to the Authority, in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee".

Relevance to the proposed project

Environmental Management and Coordination Act 1999 provide a legal and institutional framework for the management of the environmental related matters. This report has been written pursuant to section 58 (1) of this Act.

6.2.2 Environmental Impact Assessment and audit regulations 2003.

These regulations stipulate how an EIA project report should be prepared and specifies all the requirements that must be complied with. It highlights the stages to be followed, information to be made available, role of every stakeholder and rules to be observed during the whole EIA project Report making process

Relevance to the proposed project

The proposed project will be planned, designed, constructed and operated based on these regulations. It shall also be maintained and guided by the same regulations and an environmental audit study will be done periodically to monitor compliance with the set environmental standards.

6.2.3 Water Quality Regulations (2006)

The Water Quality Regulations (2006) are contained in the Kenya Gazette Supplement No. 68, Legal Notice No. 120. Water Quality Regulations apply to water used for domestic, industrial, agricultural, and recreational purposes; water used for fisheries and wildlife purposes, and water used for any other purposes. Different standards apply to different modes of usage. These regulations provide for the protection of lakes, rivers, streams, springs, wells and other water sources. It is an offence to contravene the provisions of these regulations with a fine not exceeding five hundred thousand shillings.

In addition, of immediate relevance to the proposed project for the purpose of this Project Report is Part II Sections 4-5 as well as Part V Section24.

Part II Section IV states that "Every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution".

Part IV Section 24 states that "No person shall discharge or apply any poison, toxic, noxious or obstructing matter, radioactive wastes, or other pollutants or permit any person to dump any such matter into water meant for fisheries, wildlife, recreational purposes or any other uses".

According to these regulations, "Every person shall refrain from any action which directly or indirectly causes, or may cause immediate or subsequent water pollution, and it shall be immaterial whether or not the water resource was polluted before the enactment of the Act".

Relevance

There is a perennial river which is a tributary of Nairobi River that borders the proposed site that shall be governed by this Act that. The contractor shall take care and precaution not to pollute the river in any way and if a pollution incidence occurs the contractor should notify the authority immediately.

6.2.4 EMCA (waste management) Regulation, 2006

The Waste Management Regulations (2006) are contained in the Kenya Gazette No. 69, Legal Notice No. 121. The Waste Management Regulations are meant to streamline the handling, transportation and disposal of various types of waste. The aim of the Waste Management Regulations is to protect human health and the environment. The regulations place emphasis on waste minimization, cleaner production and segregation of waste at source. The regulation requires licensing of transporters of wastes and operators of disposal site (sections 7 and 10 respectively). Of immediate relevance to proposed development for the purposes of this project report is Part II Sections 4(1-2), 5 and 6.

Section 4 (1) states that "No person shall dispose of any waste on a public highway, street, road, recreational area or any other public place except in a designated waste receptacle".

Section 4(2) and 6 explain that the waste generator must collect, segregate (hazardous waste from non-hazardous) and dispose waste in such a facility that shall be provided by the relevant local authority.

Section 5 provides method of cleaner production (so as to minimise waste generation) which includes the improvement of production processes through conserving raw materials and energy.

In section 14 (1) every trade or industrial undertaking is obliged to install anti- pollution equipment for the treatment of waste emanating from such trade or industrial undertaking.

Relevance

The Developer shall ensure that the garbage collector contracted has a valid license from the National Environment Management Authority (NEMA).

So as to comply with this, the contractor shall take precaution not to dumb wastes in areas not registered and designated as so. Further, the project proponent shall be required to ensure, through public education and other law enforcement mechanism to ensure that all road users don't dumb wastes along the road.

6.2.5 EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2009

These Regulations determine that no person or activity shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise that annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. In determining whether noise is loud, unreasonable, unnecessary or unusual, the following factors may be considered:

- Time of the day;
- Proximity to residential area;
- Whether the noise is recurrent, intermittent or constant;
- The level and intensity of the noise;
- Whether the noise has been enhanced in level or range by any type of
- electronic or mechanical means; and,
- Whether the noise is subject to be controlled without unreasonable effort or expense to the person making the noise.

These regulations also relate noise to its vibration effects and seek to ensure no harmful vibrations are caused by controlling the level of noise.

Part II Section 4 state that: except as otherwise provided in these Regulations, no person shall

a) make or cause to be made excessive vibrations annoys, disturbs, injures or endangers the comfort, response, health or safety of others and the environment; or
b) Cause to be made excessive vibrations which exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

Part III Section 2 (1) states that any person wishing to a) operate or repair any machinery, motor vehicle, construction equipment, pump, fun, air conditioning apparatus or similar mechanical device; or b) engage in any commercial or industrial activity, which is likely to emit noise or excessive

vibrations shall carry out the activity or activities within the relevant levels provided in the First Schedule to these Regulations. Any person who contravenes this Regulation commits an offence.

Section 13 (1) states that except for the purposes in sub-Regulation (2) hereunder, no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or steam or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the Second Schedule to these Regulations. These purposes include emergencies, those of domestic nature and/or public utility construction.

Section 14 relates to noise, excessive vibrations from construction, demolition, mining or quarrying site, and state that: where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose on how the work is to be carried out including but not limited to requirements regarding a) machinery that may be used, and b) the permitted levels of noise as stipulated in the Second and Third Schedules to these Regulations.

Relevance

The contractor shall be required to implement these measures, ensure that all machineries are in good working condition to reduce noise. The contractor should also make sure that all construction activities are carried out between 0800hrs -1700hrs so as not to disturb the neighbours.

6.2.6 Draft Environmental Management and Coordination (Air Quality) Regulations, 2008

The objective of these Regulations is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. The general prohibitions state that no person shall cause the emission of air pollutants listed under First Schedule (Priority air pollutants) to exceed the ambient air quality levels as required stipulated under the provisions of the Seventh Schedule (Emission limits for controlled and non-controlled facilities) and Second Schedule (Ambient air quality tolerance limits).

Relevance

The proponent shall implement the mitigation measures provided in the EMMP to prevent air pollution.

6.2.7 Occupational Health and Safety Act 2007 CAP 514.

The Act makes provision for the health, safety and welfare of persons employed in factories and other places of work. The provision requires that all practicable measures be taken to protect persons

employed in the factory and other places of work from any injury. The provisions of the act are also relevant to the management of hazardous and non hazardous wastes, which may arise at the project site. The act provides that all measures should be taken to ensure safety, health and welfare of all the stakeholders in the work place.

Relevance to the proposed project

Workers safety will be given priority during both construction and operation phases of the project

6.2.8 The Physical Planning Act of 1996 CAP 286

Part V clause 36 of the act requires that, "If in connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development, will have injurious impact on the environment the applicant should be required to submit together with the application an environmental impact assessment report."

Relevance to the proposed project

This Act provides for order in terms of development execution. This development should therefore comply with all the provisions of this law including vertical zoning requirements.

6.2.9 The Penal Code CAP 63

Chapter XVII on "Nuisances and offences against health and convenience" contained in the penal code strictly prohibits the release of foul air into the environment which affects the health of the persons. It states "Any person who voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the neighbourhood or passing along a public way is guilty of a misdemeanor"

Relevance to the proposed project

Waste disposal and other project related activities shall be carried out in such a manner as to conform to the provisions of the code.

6.2.10 The Local Government Act CAP 265

This Act provides for the establishment of authorities for local government, to define their functions and to provide for matters connected therewith and incidental thereto.

6.2.11 The Town Council of Karuri By-Laws

Project will operate within Karuri Township and is thus under jurisdiction of Town Council of Karuri. The council operates by laws to govern all aspects of town management and is also at liberty to use the various pieces of legislation to enforce conservation and pollution control measures at the

Council. Council by laws relevant to conservation, the general nuisance by laws is quite pertinent. They include:

Deposit of Rubbish

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

Noise

Any person who, in connection with any building operations, demolition or road construction work, causes or allows to be building caused noise which is so loud, continuous or repeated as to operations constitute a nuisance to the occupants of any premises in neighbourhood, shall be guilty of an offence

Approval of Building Plans

After the site has been successfully identified, plans must be drawn and submitted for approval by the local authority. Amongst other requirements, the plan must have

• Proper drainage system

• An approved incinerator or legal waste disposal facility

• Proper sanitary facilities

• Adequate natural and artificial light and ventilation

Occupational Certificate

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

Relevance to the proposed project

The Karuri Town Council is responsible for provision of services within the project area and their rules should be strictly followed

6.2.12 The Building Code 2000

The building code under Septic and conservancy tanks, section 202 allows for installation of septic tanks where a sewer system has not been provided that the proponent abides with the provisions under the set table. The area where the project is to be located is not supported by a sewer line and the proponent will ensure that wastewater treatment plant is installed as per the design attached

CHAPTER 7

7.0 IDENTIFICATION OF ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 Basis of identification of Impacts

In order to accurately identify the environmental impacts the following environmental issues were considered pertinent and important as per the "Terms of Reference" :-

7.1.1 Physical Environment (Biophysical Impacts)

a. Water quality aspects for both surface water sources like piped water, storm water, and other related aspects

b. Soil conditions, soil contamination and landscape alterations/degradation (based on aesthetic aspects) associated with the proposed project.

c. Drainage patterns especially in relation to wastewater effluents

d. Air quality aspects especially atmospheric emissions and related discharges from machinery like diesel run equipment etc.

e. Noise and vibrations where applicable

7.1.2 Natural Environment

a. Flora and fauna from the adjacent ecosystem (i.e. effects to natural plants and animals where applicable).

b. Adjacent river pollution indicators, impacts on water flow patterns and quality aspects, user interference and contamination.

c. Topography: effects on soil and landscape.

7.1.3 Social welfare, Economic and Cultural Environment

a. Determination of implications to the human society distribution, demographic details, settlement patterns, changes to the cultural lifestyle and indigenous knowledge of the local society/public where applicable.

b. Notable changes in land use systems and the general land utilization types where applicable.

c. Implications on the employees, visitors and public health, safety and related hazards/risks such as HIV/AIDS, consumption of contaminated intravenous infusions products due to disease outbreaks, sanitary facilities, etc.

d. Aesthetic, landscape alterations and changes to infrastructural facilities, among others.

e. Effects associated with the construction and operation activities and related handling and disposal of wastes generated during the operations.

f. Effects associated with income generation opportunities created by the project due to the upcoming operations.

g. Introduction of nuisances, such as pests and related multiplication breeding sites

7.2 Positive impacts

There are a number of positive benefits associated with the proposed development. The following are some of the positive benefits anticipated:

Figure 3: Positive impacts of the proposed development and justification

	Positive Impact	Justification
i)	Provision of high class and affordable housing to the residents	The proposed project will provide affordable housing to the residents with emphasis on their safety and well being
ii)	Generation of Direct & Indirect Employment and Income	Besides the direct employment by the proposed development, other forms of employment are likely to result from the spillover effects, through indirect services during the construction and operation phases. The employment opportunities will generate income and improve the living standards of the local population and its environs.
iii)	Contribution to Government Revenue	Through payment of relevant taxes, rates and fees to the government and the local authority, the project will contribute towards the national and local revenue earnings. The proponent is also expected to pay a fee to NEMA for the EIA licence of 0.05% of the total cost of the Project.
iv)	Economic investment	The proponent will receive returns on his investments hence increases in wealth
v)	Improved Security	Security will be ensured around the proposed development through distribution of suitable security lights and presence of 24 hour security guards. This will lead to improvement in the general security in the surrounding area.

7.4 Specific negative Impacts during construction and operational phases and mitigation measures

The issues that are seen as likely to negatively affect the environment and population therein include the following:

7.4.1 Air quality

NO_2 and SO_2 can cause adverse health effects, through both acute and chronic exposure. Chronic exposure may result in increased incidences of respiratory illnesses in the exposed population.

Construction phase

Dust is likely to be generated due to excavation activities, during building construction and deliveries of sand. Movement of heavy construction vehicles and the increase in traffic may cause an increase of local greenhouse gas emissions including NO_2 and SO_2. Short and long term exposure to NO_2 and SO_2 may result in the development of both acute and chronic respiratory illness. Chronic exposure may result in increased incidences of respiratory illnesses in the exposed population. The impacts although negative, may be short term, and not significant.

Operational phase

The operation of the multi residential development will lead to an increase in vehicular traffic in the area causing an increase in Carbon Monoxide and the Oxides of Sulphur and Nitrogen in the area. The levels produced by these activities however are not expected to be high and therefore the impact is minimal.

Potential mitigation measures

- Provision of full protective gear for workers. Workers shall also be sensitized on hazards encountered in such work environment and shall undergo regular health check-ups.
- Watering access roads and the site to suppress dust
- Covering truck loads using tarpaulins
- Personnel will be also provided with dust masks to avoid inhalation of the same.
- Buildings under construction will covered with adequate screens to contain dust. Stock piles will also be covered with tarpaulins
- All plants and equipment for on site preparation of pre-cast materials and concrete mixing will utilize the latest technology to have minimum emission

7.4.2 Wastewater

Site Preparation and Construction Phases

A number of persons will be employed throughout these phases of the development and hence there will be generation of sewage. If not properly disposed of and treated the sewage may have a short-term, minor negative impact on surface and groundwater quality in the area, as well as affecting general health of workers.

Operation Phase

Sewage is expected from the residential buildings and associated facilities. Sewage that is not properly treated and disposed of adequately poses a major threat on surface and ground water quality. This may also have a major impact on human health.

Potential mitigation measures

Wastewater generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of wastewater will be kept minimal.

During operation, wastewater will be channeled to the wastewater treatment plant and will be treated according to the NEMA standards before discharge.

7.4.2 Soil and Geology

Construction Phase

The activities involved in the site preparation and construction phase of the development may have a major negative and moderate impact on soil and geology of the project site. This is due to the removal of vegetation from the area which will leave considerable areas of soil exposed to the elements, which may result in soil erosion. Heavy machinery will be traversing the site due to the construction activities this may lead to soil compaction and erosion of the soil. Uncontrolled soil erosion can have adverse effects on the local water bodies.

Hazardous substances such as diesel used for the operation of machinery and stand-by generators, may be stored on the property. This may have a significant negative long-term impact on soil quality in the area.

Operational phase

The building roofs and pavements will lead to increased volume and velocity of storm water or run-off flowing across the area covered by the buildings. This will lead to increased amounts of storm water entering the drainage systems, resulting in overflow and damage to such systems in addition to increased erosion or water logging in the neighboring areas.

Potential mitigation measures

-Excavation should be done under controlled conditions which will include minimizing vegetation removal, avoiding creating large open expanses of bare soil, creating wind breaks, installation of silt traps near the rivers, using of single or few designated tracks to bring vehicles into the area and watering using water

-Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.

-Landscaping should be done on the land during the operation phase and de-commissioning phase to ensure that the same is returned to its original state. The contractor should also provide adequate soil conservation structures to ensure that areas prone to soil erosion are protected from runoff.

7.4.3 Solid waste

Construction Phase

A significant amount of solid waste will be generated in this phase through the clearing of vegetation. The other activities that will generate related solid wastes include stones, wood, broken glasses, containers, rods of metal, sharp objects (nails) etc. This will therefore have a major negative short-term impact on solid waste collection in the area. The proponent should take the initiative of removal of the solid waste which is expected to be generated during this phase of the development.

Operational phase

The project is expected to generate enormous amounts of solid waste during its operation phase. Solid waste will be generated from the residential houses and the associated facilities. The accumulation of solid waste can cause the proliferation of domestic pests such as rats (*Rattus norvegicus* and *Rattus rattus*. These vermin are very destructive and can rapidly multiply especially where garbage collection is infrequent and therefore food is abundant. This phase may also encourage stray animals such as dogs which can be nuisance species because they may bring with them ecto-parasites such as fleas (*Ctenocephalides canis*) and ticks (*Ixodes sp*.) which can create health problems for domestic pets. The bulk of the solid waste generated during the operation of the project will consist of paper, plastic, glass, metal, textile and organic wastes. Such wastes can be injurious to the environment through blockage of drainage systems, choking of water bodies and negative impacts on animal health. Some of these waste materials especially the plastic/polythene is not biodegradable may cause long term injurious effects to the environment. Even the biodegradable

ones such as organic wastes may be injurious to the environment because as they decompose, they produce methane gas, a powerful greenhouse gas known to contribute to global warming.

Potential mitigation measures for solid waste

- Express condition shall be put in the contract that before the contractor is issued with a completion certificate; he will clear the site of all debris and restore it to a state acceptable to the supervising architect and environmental consultant.
- Materials from excavation of the ground and foundation works shall be reused for earthworks and landscaping.
- Bins/ receptacles shall be placed at strategic locations within the site as collection centres to facilitate separation and sorting of the various types of wastes.
- The contractor and proponent shall work hand in hand with private refuse handlers and Karuri Town Council to facilitate sound waste management.
- The wastes shall be properly segregated and separated to encourage recycling of some useful waste materials i.e. some demolished stone and concrete materials can be used as backfills.
- Use of an integrated solid waste management system through a hierarchy options i.e. source reduction, recycling, composting and reuse shall be encouraged. This will facilitate proper handling of solid waste during operation stage.

7.4.4 Hydrogeology

Construction Phases

These phases of the development may have a moderate and negative impact on the hydrology of the area. Heavy equipment used in these phases of the development can cause soil compaction and therefore result in increased surface runoff, which changes the natural internal drainage capacity.

Operation Phase

The Operation Phase of the development is likely to have a minor negative, long-term impact on the hydrology of the area. This is however not significant as runoff levels predicted are marginal.

Proposed mitigation measures

Measures will be taken to minimize the ingress of rain water into foundation excavations. If the excavation in wet seasons is necessary, they will be dug and backfilled in short sections. Rainwater pumped out of foundation excavations will be discharged into storm drains via silt removal facilities.

7.4.5 Noise and Vibrations

The proposed project area has a number of noise sensitive receivers which include the immediate neighbouring residential houses, farms nearby and the construction workers.

Construction phase

This phase of the development may likely have the most negative impact to the ambient noise and vibration in the development area. A number of measures may be undertaken by the developer to reduce the impact of noise on the existing and potential residents as well as the workers involved in the project. This is temporary, however, and the aim at this point is to make the increase in noise as small as possible until this phase is complete. The cumulative impact of the construction activities occurring simultaneously with the other proposed developments for the area may increase the noise and vibration levels in the area significantly.

Operation Phase

This phase is not likely to cause noise pollution as residential activities do not cause any significant noise.

Proposed mitigation measures

-Equipment to be used should be selected on the basis of the noise minimization during acquisition.

-Equipment should also be properly maintained while in use during the construction phase.

-The equipment to be used should be located far away from the receivers and also so as to prevent interference, the proponent should ensure that construction is done between 0800hrs – 1700hrs during weekdays and 0800hrs – 1300 hrs on Saturdays.

-The proponent should also establish the noise levels during construction and install appropriate noise barriers and acoustic screens.

-Buffer zones of undeveloped land should be maintained between the project area and the neighbours.

7.4.6 Increased Water Demand

Construction Phase

This phase of the development might place a strain on an already limited supply through the construction of buildings and other infrastructural works proposed for the development. This will create additional demand to the water supply within the project vicinity as most people source water from Karuri Water and Sanitation Company. The impact on water availability will therefore be compatible and short-term.

Operational phase

The operation phase of the proposed Willow Park Homes might place a strain on the water availability in the area. Even with the use of recycled water for irrigation, the current supply will have a cumulative major negative impact on already limited supply. This phase of the development will therefore have a major negative long-term impact on the water availability in the area.

Potential mitigation measures

- Provision of notices and information signs within the project site to notify on means and needs to conserve water resource.
- Installation of water conserving taps will be done
- The treated effluent from the Wastewater Treatment plant will used for other uses such as; washing cars, irrigation, flushing toilets, grounds cleaning and fire suppression. This will in turn supplement the borehole water.
- During operational phase, water abstraction will be according to the amount stated in the abstraction permit
- A meter will be installed in each unit and water charges will depend on the usage of that individual unit
- Practice rain water harvesting to supplement the borehole water

7.4.7 Surface drainage

Construction phase

Clearance of land and excavation works will lead to increased soil erosion at the project site and release of sediments into the drainage systems.

Operational phase

The building roofs and pavements will lead to increased volume and velocity of storm water or run-off flowing across the area covered by the buildings. This will lead to increased amounts of storm water entering the drainage systems, resulting in overflow and damage to such systems.

Potential mitigation measures

- Terracing and leveling the project site to reduce run-off velocity and increase infiltration of rainwater into the soil.

- Drainage channels shall be installed in all areas that generate or receive surface water. The channels will be covered with gratings or other suitably approved materials to prevent occurrence of accidents and dirt entry that may compromise flow of run-off.
- The channels shall be designed with regard to peak volumes.
- Paving of the sidewalks, parking and other open areas shall be done using pervious materials i.e. concrete blocks to encourage water percolation thus reducing run-off volume.

7.4.8 Oil Leaks and Spills

It is important to note that oil/grease spills are prevalent in construction sites and in most areas that make use of petroleum products. Such products contain detrimental elements to the environment. They contain such heavy metals as mercury, lead, and sulphur among others. Though this may not be common at the site, it is wise to control and observe the little that could occur especially during maintenance of the involved machinery.

Potential Mitigation Measures

- All machinery must be keenly observed not to leak oils on the ground. This can be affected through regular maintenance of the machinery.
- Maintenance must be carried out in a designated area (protected service bays) and where oils are completely restrained from reaching the ground. Such areas should be covered to avoid storm from carrying away oils into the soil or water systems. Waste water/ wash water from these areas should be properly disposed.
- All oil products and materials should be stored in site stores or in the contractor's yard. They should be handled appropriately to avoid spills and leaks.
- Car wash areas and other places handling oil activities within the site must be well managed and the drains from these areas controlled. Oil interceptors must be installed along the drainage channels leading from such areas.

7.5 Biological Impacts

7.5.1 Flora

Site Preparation and Construction Phases

The construction phase will result in the removal of some vegetation in the site. The development may have a moderate, short-term, irreversible negative impact on the floral composition of the area. No rare or threatened species were observed. This shows that from an ecological stand-point the area

is not one of very high ecological importance. Vegetation along the riparian land will not be disturbed and a 15m width will be maintained.

Operation Phase

The activities at this phase are residential and will not have any significant impact on vegetation. The proponent will landscape with vegetation within the compound once construction activities are completed.

Proposed mitigation measures

•After project completion, proponent will rehabilitate the site by planting local trees, grass and ornamental flowers at all disturbed areas

• Project construction will disturb as little area as possible in order to minimize potential impacts on biodiversity.

• Vegetation screens will be maintained so as to reduce the visual effect of this stage of the development

• All mature trees within the development will be maintained

7.5.2 Fauna

Site Preparation and Construction Phases

Therefore, the loss of vegetation within this phase of the development may result in a direct loss of avifauna diversity and abundance within the affected habitat and an indirect loss within the neighbouring habitats.

Operation phase

After the completion of the development, the area is expected to have a conservation area adjacent to the buffer zone that will consist of existing indigenous trees. There will also be copious amount of vegetation remaining throughout the property in the short term which will be able to support the avifauna of the area.

Proposed mitigation measures

• The developer will incorporate trees that are used by bird species for foraging to attract bird species to the area.

7.5 Socio-cultural and Socio-economic Impacts

7.5.1 Increase in population (Demography)

There is currently no evidence of overcrowding in around the development area and therefore there will be minimal variations on its demography. The population growth rates in the area are

not expected to be consistent in the future however, as there has been a significant increase in the number of approved and proposed development for the Karuri town. These proposed developments will serve to attract migrants to the area who will be seeking employment during construction phase. This will result to an increase in population.

In the operational phase, the area will experience immigrants who will become the new residents of the constructed houses and this will impact on the population of the area.

Proposed mitigation measures

To mitigate on demographic impacts which might have a multiplier effect on other local conditions and associated services and infrastructure (e.g. education), the proponent will ensure maximum recruitment of labour from within daily distance from the project site, thereby reducing the number of employees and families moving into the impact area. The proponent will encourage recruitment of labour from the locals for unskilled and semiskilled labour. For skilled labour this will depend on how much is available locally and the shortfall shall be supplemented by artisans from outside.

7.5.2 Employment and Income

The residents polled in the area are excited about the increase in job availability that the development of the proposed Willow Park will bring. Any available jobs will be provide an immediate positive impact on the employment and income situation at the level of the study area as well as at the county/district and national levels. This phase of the development will provide the most benefits in terms of sustained employment and increase in income. Initially, the site preparation phase will employ specific vehicles and equipment in order to clear vegetation, for landscaping and grading and leveling and the cutting of access roads for these vehicles and laborers to access the site. This means that many skilled workers will be necessary to operate front-end loaders, excavators, bulldozers and backhoes and other vehicles. In addition to this unskilled laborers will still be necessary for other tasks. This phase of the development will therefore have a short-term major positive impact on the employment and income at the local level.

During operation phase, employment opportunities will be created e.g. at the laundry, maintenance personnel etc

Proposed mitigation measures

The proponent should encourage recruitment of labour from the locals for unskilled and semiskilled labour. For skilled labour this will depend on how much is available locally and the shortfall shall be supplemented by artisans from outside.

The proponent will give equal opportunities to women where possible.

7.5.3 Electricity

Site Preparation and Construction Phases

These phases of the development will not have an impact on the electricity supplying the area.

Operation Phase

This phase of the development will not have any impact on the electricity consumption in the area as the operations are not energy intensive ones. The developer should however implement the mitigation measures to reduce the energy bill of the development and its auxiliary activities

Proposed mitigation measures

-All electrical appliances should be switched off when not in use during construction and operation phases

-Use of energy conserving electric lamps for general lighting during operational phase

-Residents should utilize natural light when inside their houses to avoid using electricity for lighting during the day

-The contractor should ensure that all buildings have access to natural light during the day

7.5.4 Workplace accidents

Workers at the site may be exposed to various workplace accidents especially during construction period. These include being hit by falling objects and falling off from elevated heights among others. During operation period, accidents may include exposure to exposed electrical parts.

Potential mitigation measures

Occurrences of accidents may be prevented by observing the following:

- Ensuring that the operational manuals are available and accessible for every equipment /machinery used at the site.
- Proper maintenance of all machinery and equipment to prevent premature failure or possible accidents

- Ensuring all electrical equipment and machinery are properly grounded
- Only properly trained employees to operate equipment or machinery and proper instructions in their safe operation is provided.
- Workers to wear personal protective equipment (PPE)
- Naked wires should always be sealed

7.5.5 Site Security

Security of the site and those working within is of utmost significance and those operating within the facility must be assured of their security at all times. Security lapses that may lead to injury of occupants of the building and loss of personal property should be taken care of.

Potential mitigation measures

- The management shall strategically install lighting as well as security alarms and backup systems including surveillance of the area on a 24 hours basis.
- Security guards shall guard the property in a 24-hour basis and document any suspicious movement within the facility and its environs.
- The proposed site already has a fence.

7.5.6 Fire hazards

The operations that lead to fire outbreaks include poor handling of electricity systems, faulty electrical equipment, carelessness etc. These should be avoided both during construction and operation phases of the project.

Potential mitigation measures

In this regard, the design of the project has provided and recommended implementation of fire fighting measures and control facilities. These include the following:

- Installation of an automatic fire alarm system for the building
- Provision of firefighting equipment and hydrant points
- Display fire excavation procedures and emergency at the buildings
- Regular maintenance of fire electrical and first aid equipment
- Provision of sufficient fire exit points and fire assembly points

7.5.7 Road infrastructure

Construction phase

Traffic along Banana- Raini road may slightly increase during construction phase since Lorries will be accessing the site delivering construction materials and taking away wastes. The roads in their current states may not be able to handle the increase in heavy-duty equipment traffic. This phase of the development may have a major negative impact on the present road network in the study area.

Operational phase

During the operation phase of the project, there might be a major negative impact on the road network in the area as the volume of traffic associated with the development will increase significantly, therefore placing a strain on the road network .

Within the immediate environs of the project site the following traffic rules will be observed:

- A traffic marshal shall be stationed along Banana- Raini road within the project boundary to control vehicles during transportation of materials.
- Maximum speed limit within this area will be 10km/hr for both operation and personal vehicles
- Speed limits and all other road signs and traffic rules shall be strictly observed.
- Vehicles will be used for the purposes to which they are intended only.

7.5.8 Occupational Health and Safety (OHS)

Construction phase

During the proposed works, there may be increased risks to health and safety such as dust, air, and noise pollution. The workforce and general public involved would be more subjected to these environmental hazards and disturbances. Foods for the construction workforce are usually provided by individuals most of who in most cases operate without license. This can compromise health of the workers especially if such foodstuff is not prepared following strict hygiene standards.

Flammable substances including diesel and motor oil may be stored or used within the project site for heavy-duty equipment. These substances are precursors for fires and explosions, which may range from small incipient to larger fires of great intensity, which generates heat causing damage to property, injuries or loss of human life.

Operational phase

It is expected that most residents will used LPG for cooking which is also highly flammable, which may increase the vulnerability of the operation to a fire or an explosion.

Potential mitigation measures

During construction, the contractor will be required to prepare a waste management plan for the work sites and equipment camp at the start of the project. The site is to be kept clean, neat and tidy at all times. The contractor shall implement measures to minimize waste and develop a waste management plan to include the following:

- All personnel shall be instructed to dispose of waste in designated waste baskets.
- At all places of work, the contractor shall provide litter collection facilities.
- The final disposal of the site waste shall be done at the location that shall be approved by the engineer on site. This must be in full recognition of the existing legal requirements.
- There shall be provision of sufficient bins to store the solid waste produced on a daily basis.
- Wherever possible, materials used or generated by construction shall be recycled. Provision shall also be made of responsible management of any hazardous waste generated during the construction works.
- Workmen shall be provided with suitable protective gear (such as dust masks, ear muffs, helmets, overalls, industrial boots etc) particularly during construction. There must be fully equipped First Aid kits on site and a safety officer who has First Aid training and knowledge of safety procedures. In addition, the contractor must have insurance for the workmen.
- The contractor will be required to adhere to Occupational Safety and Health Act (OSHA) of 2007, especially the building operations and works of engineering construction rules and its subsidiary and supplementary regulations on safety and public health in the construction activities.

7.5.9 HIV/AIDS

The proposed development will lead to immigration of people from outside the local areas in search of employment opportunities both during construction and operational phases.

During operational phase, immigration is also expected since the objective of this proposed project is to provide better affordable housing to Kenyans. Therefore, this increase of people in the project areas may lead to increased incidences of sexually transmitted diseases which may exacerbate HIV/AIDS situation among the locals.

Potential Mitigation Measures

-Conduct awareness campaigns on HIV/AIDS among the workers, residents and the locals. This can be undertaken by the various NGOs and government agencies in the county.

7.5.10 Transportation

Site Preparation and Construction Phases

Access to public transportation is currently not a problem within the development area. This is further enhanced by the close proximity to the Banana- Riani Road. This stage will therefore not have an impact on the transportation network in the area.

Operation Phase

The increase in the population numbers of the development may have a minor positive impact on the transportation options of the study area, as the development may encourage a bus stop to open up within the area. Persons would therefore be able to travel more freely between the community and the rest of the county. On the other hand, more workers may have an impact on the transportation system if this does not materialize.

Potential Mitigation measures

The developer will improve the road network which provides access to the project area. This should be accompanied by an upgrade in the drainage along this road network. Ideally the road improvement works should take place prior to the infrastructural works at the development site. These road improvements must be scheduled between 9:00 a.m. and 4:00 p.m daily, so as not to disrupt traffic in the area and to abate the increase in ambient noise levels in the area.

7.5.10 Conflict with the community

Projects of such magnitude usually attract public uproar (especially from the neighbouring residents and community) if they are not made to own the project. Conflicts usually arise mostly from the foreseen negative impacts.

Potential Mitigation measures

Consultation with neighbours on the mitigation measures prescribed for the negative impacts as a way of conflict resolution and neighbourhood association.

The proponent will give women equal employment opportunities as men whenever possible.

Figure 4: Summary of the impacts of the proposed development

Environmental &Social Component	Nature of Impact (Positive/negative)	Project Phase	Positive	Negative	Neutral
Bio-Physical Environment					
Land resources	Altered topography and landscape Loss of farmland and loss of vegetation	Pre-construction & Construction		(-) (-)	
	Soil contamination	Construction & Operation		(-)	
	Soil erosion	Pre-construction& Construction		(-)	
	Generation of both Solid and liquid wastes	Construction		(-)	
River degradation	Pollution- Water quality degradation by waste materials, Oil spills from construction equipments and vehicle	Construction & operation		(-)	
	Slumping and Sedimentation	Construction		(-)	
	Disturbance to drainage and removal of vegetation	Pre-construction& Construction		(- -)	
	Conflicting interests of water users (contractor and the community)	Construction		(-)	
Solid wastes	A significant amount of solid waste will be generated in this phase through the clearing of vegetation, construction debris and during operational phase	Construction and operation		(-)	

Environmental &Social Component	Nature of Impact (Positive/negative)	Project Phase	Positive	Negative	Neutral
Ambient Air Quality and noise	Noise pollution generated by construction activities, construction machinery and vehicular traffic. Deposition of airborne road dust and airborne emissions from vehicles and construction equipment through construction activities.	Construction and operation		(-)	
Sewage & effluent	Environmental pollution especially to water bodies Public health hazard	Operation		(-)	
Apartments	Change in natural drainage pattern	Construction and operation		(-)	
	Better affordable housing		(++)		
Aesthetic quality Flora and Fauna	Change in landscape Disturbance in the natural drainage system Altered plant species Loss of or disturbance to natural habitants	Preconstruction Construction & Operation		(-) (-) (-) (-)	
Socio-economic Environment					
Health & Safety	Deposition of airborne road dust and airborne emissions from vehicles and construction equipment	Construction & operation		(--)	
	Occupational hazards Risks of construction workers being hit by falling objects and falling off from elevated heights.	Construction & operation		(--)	
	Increase in population in the project area may lead to increased incidences of sexually transmitted diseases which may exacerbate HIV/AIDS situation among the locals.	Construction & operation		(--)	

Environmental &Social Component	Nature of Impact (Positive/negative)	Project Phase	Positive	Negative	Neutral
Conflict with the community	Conflicts may arise especially from the neighbouring residents and community if they have not been fully consulted.	Construction & operation		(-)	
Population increase	The area will experience immigrants who will become the new residents of the constructed houses and this will impact on the population of the area.	Construction & operation		(-)	
Socio-cultural	In migration of people from different regions may lead to behavioral influences	Construction & Operation		(--)	
	Will enhance national and regional development	Construction & Operation	(+)		
	Ultimately alleviate poverty and enhance security of the area		(++)		

Key:

Major Negative impact	(--)
Minor Negative impact	(-)
Major Positive impact	(++)
Minor Positive impact	(+)
Neutral impact	

CHAPTER 8

8.0 ENVIRONMENTAL & SOCIAL MANAGEMENT & MITIGATION PLAN (ESMMP)

8.1 Significance of ESMMP

This is aimed at identifying mitigation measures for negative impacts already identified so that the mitigation measures are incorporated. The mitigation measures will on the one hand eliminate or offset adverse environmental and social impacts or reduce them to acceptable levels and on the other hand reinforce measures for enhancements.

The strategies employed for impact mitigation are avoidance, reduction and remedy as suggested in the figure 5 below.

8.2 Environmental monitoring and audits

Environmental monitoring and audits are essential in Projects life span as they are conducted to establish if project implementation has complied with set environmental management standards for Kenya as spelt out in EMCA 1999 and the Environmental (Impact Assessment and Audit) Regulations 2003. In this Project, environmental monitoring and audit will be conducted to ensure that identified potential negative impacts are mitigated during the project's life span.

Figure 5 below provides environmental & social management & mitigation plan (ESMMP)

Environmental and Social	Mitigation measure	Project Phase	Monitoring activity	Responsibility	Frequency& Estimated Cost
Bio-physical Environment					
Disturbance to fauna and flora	- Maintain a 15 m distance from the river bank -Set up a conservation area within the site which will contain undisturbed native tree species along the shorelines of the river. -Maintain all mature trees within the development - Confirm sites and locations in order to avoid disturbing unnecessary areas with existing vegetation -After project completion, proponent should rehabilitate the site by planting local trees, grass and ornamental flowers at all disturbed areas -Retain vegetation screens to reduce the visual effect of this stage of the development - The developer should incorporate trees that are used by bird species for foraging to attract bird species to the area.	Construction & Operational	Inspection	Civil Engineer in charge /Contractor	100,000.00 During the project implementation

Environmental and Social	Mitigation measure	Project Phase	Monitoring activity	Responsibility	Frequency& Estimated Cost
Soil Degradation	-Open stockpiles of construction materials to be covered with tarpaulin or similar fabric during rainstorms. -Excavated soil to be used for back filling -Limit the use of heavy machinery and control earth works -Provide soil conservation structures on areas prone to soil erosion to reduce impact by run-off -Control construction activities especially during rainy seasons - Ensure that the drainage plan proposed is implemented as stipulated on the plan. -The provision of a system of culverts should be considered. -Conduct landscaping after project completion to maximally control any possible chance of soil movement. -The proponent will maintain a 15m buffer zone so as to protect the riparian ecosystem from erosion	Construction	Inspection	Civil Engineer / Contractor	Routine
River degradation	-Limit construction activities at least 15m away from riparian land -Proper treatment of effluent -Dechlorination of the excess treated effluent before discharging into the river	-Construction	periodic monitoring of morphological changes	Engineer in Charge	-

Environmental and Social	Mitigation measure	Project Phase	Monitoring activity	Responsibility	Frequency& Estimated Cost
Air pollution/ particulate matter (dust)	-Stockpiles of earth should be sprayed with water or covered during dry seasons. -Buffer area of trees and other vegetation will serve as natural windbreaks -Provide PPE such as nose masks to the workers in dust generation areas. -All raw materials must be sourced as close as possible to the construction site thus reducing the emissions from vehicular traffic. - Machines must not be left idling for unnecessary periods of time. -Vehicle speeds in the construction area will be limited to minimize dust in the area - The construction contractor to water the site with exposed soil surfaces twice daily during dry seasons • Avoid pouring dust materials from elevated areas to ground • Cover all trucks hauling soil, sand and other loose materials • Provide dust screen where necessary	-Construction	Inspection	Civil Engineer in charge / Contractor	75,000.00

Environmental and Social	Mitigation measure	Project Phase	Monitoring activity	Responsibility	Frequency& Estimated Cost
Sewage and Effluent	-Routine checkups and monitoring of the sewage treatment plant to avoid leakages and blockages -The proposed capacity of the WWTP is sufficient to accommodate the anticipated population -Proper construction of the WWTP will be done to meet the standards required by Karuri Town Council -Construction of separate storm water and waste water drains -Proponent to ensure that the sewage treatment plants are maintained regularly and that all effluent released is within or below the standards for effluent as stipulated by the NEMA, Water Quality Regulations, 2006.	Construction & Operation	Inspection & effluent analysis	Civil Engineer in charge Excloosive Engineers	450,000.00
Drainage	-Ensure that the drainage plan proposed is implemented as stipulated on the plan. -Additional drainage may be put in place to convey the flood discharge -The provision of a system of culverts should be considered. -Ensure that all drains and culverts collecting water within the site are regularly cleaned and maintained.	Construction Operation	Inspection	Architect, Project Manager, Contractor and proponent Proponent/Property Manager(s)	To be determined

Environmental and Social	Mitigation measure	Project Phase	Monitoring activity	Responsibility	Frequency& Estimated Cost
Noise & vibrations	-Provide and enforce use of PPE e.g. ear muffs especially to workers working with machinery, vehicles and instruments that emit high levels of noise -Proper servicing of machinery & equipment(oiling, greasing etc) -Construction activities to be carried out between 0800-1700hrs -Monitor noise levels as per NEMA guidelines - Provision of barriers such as walls around the site boundaries to provide some buffer against noise -Installation of portable barriers to shield compressors and other small stationary equipment where necessary - Put up signs to indicate construction activities -Use of silenced machinery and instruments	Construction	Stress on ears	Engineer in charge	50,000.00
Increase in Solid Wastes	-Solid wastes to be put in a designated area for appropriate disposal -Limit quantity by proper planning and recycling - Contractor and proponent to work hand in hand with private refuse handlers and Karuri Town Council to facilitate waste handling and disposal from site. -Debris to be collected, transported and disposed	Construction	Observation	Engineer in charge	20,000.00

	off at suitably approved dumpsites -Debris to be properly segregated to encourage recycling of some wastes. Demolished stones can be used as backfills -Bins/ receptacles to be placed at strategic locations within the site as collection centres to facilitate separation and sorting of the various types of wastes. -Residents to engage services of a private waste handler to collect at regular intervals	Operation			
Socio-economic Impacts					
Increase in water demand	-Ensure that there is adequate water available to supply the increase in demand that the construction activities will pose. -Provision of rainwater harvesting structures -Abstract as indicated in the WRMA permit -Installation of toilet flushes with low volume cisterns -Recycling of water especially the treated waste water from the WWTP to be used for flushing, watering lawns and washing purposes	Construction Operational	Water meters	Civil Engineer / WRMA	Daily 140,000.00

Environmental and Social	Mitigation measure	Project Phase	Monitoring activity	Responsibility	Frequency & estimated Cost
Occupational Health and Safety	-Personnel to stick to standard operation procedures -Personnel to wear complete protection gear -Provision of fire fighting equipment -Put in place an emergency response plan -Only qualified personnel to operate the machinery -Adequate sanitary facilities should be provided and standard cleanliness maintained - Ensure proper solid waste disposal and collection facilities - Proper treatment of wastewater - Construction activities must therefore be limited between 0800hrs and 1700hrs - First aid kit to be provided on site and ensure that a crew member is trained in basic first aid practices. - Signs to be placed around the construction site displaying the number of the persons responsible for handling emergencies on the site -Contractor to have workmen's compensation cover which should comply with workmen's compensation Act	Operation & construction	Continuous inspection of machinery	Engineer in charge	105,000.00

Environmental and Social	Mitigation measure	Project Phase	Monitoring activity	Responsibility	Frequency & estimated Cost
Population Increase	-Proponent to ensure maximum recruitment of labour from within daily distance from the project site, to reducing the number of employees and families moving into the impact area. -Ensure adequate social and other infrastructure to meet needs of new residents	Operational	Pressure on land resources	Local administration	-
Human Sanitation and Waste Management	-Provision of sufficient sanitary conveniences and hand washing stations, mobile toilets at work site -Ensure proper containment of disposal of sanitary waste	Construction	Foul odour	All field stakeholders	80,000.00
Public Health	-Implement HIV/AIDS and other communicable diseases programmes in conjunction with relevant ministries	Throughout	Awareness	All	Monthly 120,000.00
Dehydration of personnel	-Provide safe and clean drinking water	Construction	Personnel physical condition	Engineer in charge	Daily
Conflict	-Consultation with neighbours on the mitigation measures prescribed for the negative impacts as a way of conflict resolution and neighbourhood association. - Where possible offer women equal opportunities as men - Persons from the nearby communities should be employed to work on the construction site	Preconstruction & construction		Proponent & Contractor	As required

CHAPTER 9

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusion

The proposed project will provide accommodation facilities to many families and will therefore address the current demand for housing in Nairobi. The activities for which the proposed development is intended are not such that they are likely to interfere with the peace of the neighbours. The project has been planned in full cognizance of the requirements of the neighbourhood where it is to be implemented and all standard planning considerations have been taken into account and given the attention they deserve. The project is an environmentally low risk project and thus poses no significant threat to the environmental aspects of the area. The likely environmental impacts expected from the implementation of the building are minimal and will be restricted to construction stage. Appropriate mitigative measures have been put in place to take care of these both in the design of the project and operational phase.

9.2 Recommendations

The proponent and contractor are advised to implement the Environmental & Social Management & Mitigation Plan (ESMMP) so as to reduce adverse impacts and boost good environmental practices. Guidelines on environment, health and safety must also be followed in order to reduce incidences of accidents, health problems and compromise to environmental well being.

Recommendations for the prevention and mitigation of adverse impacts are as follows: -

i. The proponent should provide signage in the proposed project site to inform neighbours and the local community on the activities taking place
ii. Ensure that worker's occupational health and safety standards are maintained through capacity building, proper training, providing protective clothing
iii. The proponent/contractor should ensure that the proposed management plan is fully implemented
iv. Heavy construction activities should be limited (or avoided) during the rainy season to minimize the chances of soil degradation (soil erosion). Maintenance activities must be carried out in service bay to reduce chances of oils or grease or other maintenance materials, from coming into contact with environment (water or soil). Wastewater from such areas must be refrained from coming into contact with solid mass or water bodies as it contains oil/grease spills.

v. All activities concerning construction and maintenance such as, work execution, site inspection, and material testing, shall be strictly monitored by an engineer or a designated official. This is important to ensure quality of maintenance works. Engineers and/or designated official shall be trained and experienced enough to judge the appropriateness of the work executed in order to carry out the monitoring properly.

vi. Construction activities must be undertaken only during the day i.e. between 0800 hours to 1700 hours. This will minimize disturbance to the general public within the proximity of the site/project especially the residential estates

vii. Rainwater harvesting systems should be provided as well as standard storage systems to every unit to enhance collection of the run- off generated from the roof catchments.

viii. Before the proponent drills a borehole, a hydrogeology report and an Environmental Impact Assessment report should be conducted and approval from WRMA sought

ix. All solid waste materials and debris resulting from construction activities must be disposed off at approved dumpsites. There should proper waste segregation to allow for recycling. Some excavation such as stone materials should be used for backfilling.

x. There is need for community and workers' awareness creation on the environmental management issues, and the need for all project-affected populations to cooperate in the projects construction, operation and maintenance.

xi. Once the residential buildings are completed and fully occupied, the residents should engage services of waste management companies registered by NEMA in compliance with Environment Management and Coordination (Solid Waste) Regulations 2006.

xii. The proponent should apply for a NEMA Effluent Discharge License before discharging any effluent to the environment and should also engage a NEMA designated laboratory to carry out effluent analysis on a quarterly basis.

xiii. A complete fire fighting system must be provided after completion of the project. This must be installed or provided at strategic points.

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APPENDICES

- Stakeholders Comments
- Public Consultation Questionnaires
- Terms of Reference Exhibit
- Title Deed
- Change of user certificate
- Bill of Quantities
- Architectural Designs