ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED LANCET VILLAGE ON PLOT NO. MAVOKO TOWN BLOCK 2/19052 AT KATANI, MAVOKO SUB COUNTY, MACHAKOS COUNTY

MARCH 2017

PROPONENTS
LANCET HOUSING COOPERATIVE SOCIETY LIMITED,
5TH AVENUE OFFICE SUITES,
5TH AVENUE, OFF NGONG ROAD, UPPER HILL,
P.O. BOX 117 – 00202,
NAIROBI

LEAD EXPERT
MR. ONGETO WALTER OMWENGA
P.O. BOX 17874-00500 NAIROBI
NEMA REG NO. 2315
0722 287 316

GENERAL

PROJECT TITLE

Environmental Impact Assessment study report for the proposed Lancet village on plot No. Mavoko Town Block 2/19052, at Katani, Mavoko Sub County, Machakos County

PROJECT LOCATION

The proposed project site is located within Katani Sub Location, Muthwani ward, Mavoko constituency. The proposed site neighbors St. Joseph's Integrated primary school and Shangilia Baba na Mama Micro-intervention programme merry go round loan housing.

PROJECT PROPONENTS

LANCET HOUSING COOPERATIVE SOCIETY LIMITED,
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NAIROBI

PROJECT VALUE

KSHS 800,000,000.00

PIN NUMBER

P051473170C

CONTACT PERSON

MR. PATRICK WERE
CHAIRMAN
LANCET HOUSING CO-OPERATIVE SOCIETY LTD
TEL: +254703061000

LEAD EXPERT

MR. ONGETO WALTER OMWENGA
P.O. BOX 17874-00500
NAIROBI
NEMA REG NO. 2315
0722 287 316

PROJECT COORDINATES

1°21'7.67"S
36°59'15.91"E

CERTIFICATION

This environmental impact assessment study report was prepared by **MR. ONGETO WALTER OMWENGA (NEMA Reg. No. 2315**). The report has been done with reasonable skills, care and diligence in accordance with the Environmental management and Co-ordination Act, 1999 and the Environmental Impact Assessment and Audit Regulations, 2003.

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

LEAD EXPERT **MR. ONGETO WALTER OMWENGA**

P.O. BOX 17874-00500 NAIROBI

waltermwe@gmail.com/wnemaconsultant@gmail.com

REG. NO.: 2315

0722 287 316

SIGN..... **DATE**.....

PROPONENT **LANCET HOUSING COOPERATIVE SOCIETY LIMITED**

5TH AVENUE OFFICE SUITES,
5TH AVENUE, OFF NGONG ROAD, UPPER HILL,
P.O. BOX 117 – 00202
NAIROBI

SIGN……DATE……

ACRONYMS

EIA	Environmental Impact Assessment
EMCA	Environmental Management Coordination Act
EMP	Environmental Management Plan
Ha	Hectare
KM	Kilometres
NEC	National Environment Council
NEAP	National Environment Action Plan
NES	National Environment Secretariat
NGOs	Non Governmental Organizations
PEC	Poverty Eradication Commission
PPE	Personal Protective Equipment
TOR	Terms of Reference

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EXECUTIVE SUMMARY

Environmental Impact Assessment is a tool for environmental conservation and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA) No.8 of 1999 second schedule 9 (1), and Environmental (Impact Assessment and Audit) regulation, 2003, such projects classified as either high or medium risk must undergo an environmental impact assessment to determine their suitability and identify possible negative impacts that may be arise as a result of the project. The EIA study report of which must be submitted to National Environment Management Authority (NEMA) for review and licensing. This is necessary as many development activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development without interfering with the environment. This report consists of an executive summary followed by detailed content that elaborate this executive summary. The executive summary details the various components of the report as follows.

Scope Objective and Criteria of the Environmental Impact Assessment study (EIAs)

Mr. Ongeto Walter, a NEMA registered and licensed lead expert in Environmental Impact Assessment and Auditing was appointed as a Consultant to conduct a detailed EIA study for the proposed Lancet Village project located within Katani area of Machakos County. The scope of the assessment covered the design of the project, ground preparation, builders' works which include masonry, and installation of service lines as well as the utilities required within the proposed village such as water supply, electricity supply and waste water management systems. The output of this work was a comprehensive Environmental Impact Assessment study report that shall provide an EMP to guide operations at the construction site and for applying for a NEMA licence.

The consultant on behalf of the proponents conducted the EIA study by incorporating but not limited to the following terms of reference:

a. Location of the proposed project
b. A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
c. The objectives of the proposed project.
d. The technology, procedures and processes to be used, in the implementation of the project.

e. The materials to be used in the construction and implementation of the project.
f. The products, by-products and waste to be generated by the project.
g. A description of the potentially affected environment.
h. The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
i. To recommend a specific environmentally sound and affordable wastewater management system.
j. Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.
k. Analysis of alternatives including project site, design and technologies.
l. An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.
m. Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the cause of carrying out development activities.
n. Propose measures to prevent health hazards and to ensure security in the working environment for the employees, residents and for the management in case of emergencies.
o. An identification of gaps in knowledge and uncertainties which were encountered in compiling the information.
p. An economic and social analysis of the project.

Methodology Outline

The following methods were applied in this EIA study process.

- Identification of environmental hazards associated with the proposed development through literature review.
- Public participation in the project development
- Recognition of social and cultural principles
- Polluter pays principle and the precautionary principle

The EIA study process also involved consultation with the project proponents as well as;

- Review of various statutes relating to environmental protection in Kenya, and the Environmental Management and Co-ordination Act (1999)

- Review of similar past studies and reports.
- Primary Information on the site obtained through site surveys and inspection.

Management systems put in place for minimizing risks of environmental impacts were determined via interviews with the neighbour through; questionnaires, interviews and photographic documentation of the site and review of the approved drawings.

Project Description

The proposed project involves the construction of mansionettes and apartments housed within three storey flats. The proposed project shall provide a total of one hundred and ninety (190) units of two, three and four bedroomed type all built within a gated community on a ten (10) acre piece of land.

The proponents have proposed to construct one hundred and six (106) four bedroomed mansionettes and fourteen blocks of flats all three storeyed that shall house a total of eighty four (84) units ; seventy two (72) three bedroomed master ensuite units and twelve (12) two bedroomed units. Each unit within the Lancet Village shall be provided with two parking spaces and common properly cabro paved driveways.

The following are additional common facilities that have been provided within the village:

- ✓ A borehole shall be sunk to ensure adequate water supply to the residents
- ✓ A boundary wall with an electric fence on top
- ✓ A commercial centre that shall provide a gym, bar, restaurant, clinic/pharmacy and mini market
- ✓ A swimming pool
- ✓ Landscaped gardens across the entire village
- ✓ Waste water treatment plant
- ✓ Kindergarten
- ✓ Backup generator

Impacts and Mitigation Measures

There are both negative and positive impacts associated with the proposed project. These impacts were identified according to phases namely: Construction Phase and Operational Phase. In general the following positive impacts are associated with the proposed development;

- Improved security around the project area
- Optimal use of the idle land
- Increase in the number of modern national housing stock
- Several employment opportunities shall be created
- Creation of market for the supply of various construction materials hence improving various businesses within and around the project area.
- Improvement of infrastructural facilities in the area especially the access road.
- Gains to the county and national governments economies through payment of various levies and taxes

The possible negative impacts that may arise due to implementation of the proposed project are:

- Noise pollution from construction activities
- Poor disposal of excavated soils that might lead to environmental degradation.
- Increased water demand
- Air pollution through the emitted dust especially during the construction and decommissioning phases
- Solid waste generation
- Increased population within the project area

In order to alleviate the negative impacts associated with the proposed project the proponents shall put in place various measures as shown in the report more specifically in the EMP and any other measures that may be suggested by the authority.

Conclusion

It is quite evident that the construction and operation of the proposed project will bring positive effects in the project area including creation of employment, quality shelter, improved infrastructure, increase in national housing stock and increase in revenue to the county and national government among others. However, despite the several positives from the proposed project, negative impacts shall also be experienced hence the need to mitigate them. The negative impacts of this project include noise pollution, air pollution, generation of solid and liquid wastes among others.

On the basis of the above and taking cognisance of the fact that the proponents has proved financially and environmentally credible, it is our recommendation that the project be

allowed to go on provided the mitigation measures outlined in this report are adhered to and the Environmental Management Plan (EMP) is implemented to the letter.

The following table shows major anticipated impacts from the proposed project and the possible mitigation measures to the impacts

Possible Impact	Mitigation Measures
Solid waste	▪ Waste minimization by avoiding unsustainable construction practices ▪ Provision of waste collection bins and cubicles for collection and temporal holding of the generated waste within the site before disposal ▪ Reuse and recycle materials where necessary ▪ Purchase construction materials in quotas to avoid wastage ▪ Provide solid waste handling containers within the proposed project site to help in proper collection and management ▪ Contract a registered solid waste collection company to assist in the disposal of the generated and collected solid waste to the county's designated final disposal site ▪ Ensure separation at source of the solid waste generated on site is done to enhance reusing of any material recovered from the site
Storm water management	▪ Harvesting of rain water and reuse ▪ Designing and construction of surface storm water drainage to avoid any chance of flooding either within and outside the project area ▪ Ensuring that the speed of the storm water is reduced as it flows downstream
Air pollution	▪ Ensure strict enforcement of on-site speed limit regulations ▪ Avoid excavation works in extremely dry weather ▪ Sprinkle water on graded access routes each day to reduce dust generation ▪ Consider recarpeting the access road to the proposed site to reduce the amount of dust generated ▪ Construct a hoarding before any construction activities commence on site ▪ Provide dust nets on the upper floors to prevent the spread of dust to neighbouring residential houses and must be retained until all construction activities are done ▪ Ensure all trucks delivering construction materials such as sand are properly covered to prevent the spread of dust. ▪ Ensure proper planning of transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done per vehicle or the number of vehicles on the road ▪ Provide adequate personal protective gear especially nose masks to employees ▪ Ensure all transportation trucks are covered while carrying away excavated soils and construction debris for final disposal
Noise pollution	▪ Ensure that construction machinery are kept in good condition through regular servicing and maintenance to reduce the amount of noise generated ▪ All construction activities must be limited to between 8am and 5pm during weekdays and 8am to 3pm on Saturdays. No construction activities shall be done on Sundays and public holidays ▪ No construction activities shall be carried out on site at night ▪ No blasting of stones if any shall be carried out within the project without prior notice being issued to local residents ▪ Trucks bringing in construction materials should be used to ferry away any

	construction debris for disposal in order to reduce the number of vehicles to the site ▪ Ensure that all generators and heavy duty equipment are insulated or placed in enclosures to minimize ambient noise levels
Effluent discharge	▪ Provide a reliable method of waste water management that can serve the projected population such as waste water treatment plants since the project area does not have a functional sewer line ▪ The proponents must also apply and obtain a NEMA discharge license ▪ Monitor effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated ▪ Ensure that no waste water is discharged into the immediate environment ▪ Ensure that such facilities are adequate for all the employees on site across this phase and are cleaned on a daily basis
Occupational health and safety of employees, neighbours and visitors to the site	▪ Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency and carry out regular drills to test such procedures ▪ Ensure that adequate provisions are in place to immediately stop any operations where there in an imminent and serious danger to health and safety and to evacuate workers. ▪ Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site ▪ Provide adequate well stocked first aid boxes across the site and adequately train all staff on basic first aid administration while on site ▪ Provide adequate fire fighting equipments such as portable fire extinguishers at strategic locations within the site and ensure they are regularly serviced ▪ Adequate warning and instruction signs be prominently displayed within the project site ▪ Ensure that workers at the construction are adequately protected through provision of suitable personal protective gears ▪ Limit public access to the construction site and ensure any visitor to the site are properly briefed on the basic safety measures and provided with basic safety attires before accessing the site ▪ Ensure that all construction machineries are operated by experienced personnel and regularly serviced in order to avoid any accidents while on site
Ecosystem disturbance	▪ Ensure proper demarcation and delineation of the project area to be affected by construction works ▪ Designate access routes and parking within the site ▪ Design and implement an appropriate landscaping programme to help in re-vegetating the project site after construction activities are complete.

1 INTRODUCTION

1.1 Scope objective and criteria of the Environmental Impact Assessment study

1.1.1 Scope

The Kenya Government policy on all new project, programmes or activities requires that an environmental impact assessment is carried out at the planning stages of the proposed project to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation and decommissioning of the facility. The scope of this full project, therefore, covered:

i. The baseline environmental conditions of the area,
ii. Description of the proposed project,
iii. Provisions of the relevant environmental laws,
iv. Identification and discuss of any adverse impacts to the environment anticipated from the proposed project,
v. Appropriate mitigation measures,
vi. Provision of an environmental management plan outline.

The overall objective of the project on the other hand is to ensure that all environmental concerns are integrated in all the development activities in order to contribute to the sustainable development. Specifically the objectives are: -

i. To identify potential environmental impacts, both direct and in direct.
ii. To assess the significance of the impacts
iii. To assess the relative importance of the impacts of relative plans designs, and sites
iv. To propose preventive mitigating and compensative measures for the significant negative impacts of the project on the environment
v. To generate baseline data for monitoring and evaluation of how well the mitigating measures are being implemented during the project cycle.
vi. To present information on impact of alternative
vii. To present the results of the EIA study that can guide informed decision making and
viii. To prepare EMP for the proposed project and decommissioning plan.

1.1.2 Terms of Reference (TOR) for the EIA study Process

Mr Ongeto Walter Omwenga was appointed as a Consultant to conduct an Environmental Impact Assessment for the proposed Lancet Sacco Housing project in Katani, Mavoko Sub County/constituency, Machakos County. The scope of the assessment covered site preparation works, construction works of the proposed development that included ground preparation, masonry and installation of service lines as well as the utilities required by the residents. The output of this work was a comprehensive full study report for the purposes of applying for an EIA licence.

It was recognised that any form of development such as the proposed housing project is likely to impact the site and the surrounding environment hence, before any commencement of any work, there was an urgent need to carry out an Environmental Impact Assessment in compliance with the Environmental Management and Coordination Act (EMCA) of 1999 and the Environmental Impact Assessment/Audit Regulations 2003.

The project included the necessary specialist studies to determine the environmental impacts relating to the biophysical and socio-economic aspects and to determine the issues or concerns from the relevant authorities and interested and/or affected parties. The appropriate measures to ensure co-existence of the proposed development with other social and economic activities in the area are provided as part of mitigation measures and Environmental Management Action Plan.

The main objective of the assignment was to assist the proponents to conduct an environmental impact assessment for the proposed housing project and prepare an EIA study report for the proposed project to ensure that the proposed development takes into consideration appropriate measures to mitigate any adverse impacts to the environment. The project identified existing and potential environmental impacts and possible concerns that interested and/or affected parties have with the proposed development, as well as the associated prevention and mitigation measures for the negative impacts as stipulated in the environmental Management Plan (EMP) proposed.

The consultant conducted the project by incorporating but not limited to the following terms of reference:-

a. Location of the proposed project
b. A concise description of the national environmental legislative and regulatory framework, baseline information and any other relevant information related to the project.
c. The objectives of the project.
d. The technology, procedures and processes to be used, in the implementation of the project.
e. The materials to be used in the construction and implementation of the project.
f. The products, by-products and waste to be generated by the project.
g. A description of the potentially affected environment.
h. The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
i. To recommend an efficient, environmentally sound and affordable waste water management system.
j. Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.
k. Analysis of alternatives including project site, design and technologies.
l. An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.
m. Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the course of the project implementation.
n. Propose measures to prevent health hazards and to ensure a secure and habitable working environment for the construction employees, neighbours and for the management in case of emergencies.
o. An identification of gaps in knowledge and uncertainties that were encountered in compiling the information.
p. An economic and social analysis of the project.
q. Such other matters as the Authority may require.

1.1.3 Data collection procedures

First, the consultant undertook environmental screening and scoping to avoid unnecessary data. The data collection was carried out through questionnaires/standard interview schedules, use of checklists, observations and photography, site visits, desk top environmental studies and scientific tests, where necessary in the manner specified in Part V (section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003.

1.1.4 EIA study organization and structure

The EIA study was carried out to full completion within a period of twenty days from the date of contract signing. The consultant coordinated the day-to-day functions and any related institutional support matters. Otherwise, all formal communications were directed to NEMA from the proponents were done through the consultant/project lead expert.

1.1.5 Reporting and documentation

The EIA study report was compiled in accordance with the guidelines issued by NEMA for such works and was prepared and submitted by the lead expert on behalf by the proponents for consideration and licensing. The expert ensured constant briefing of the client during the exercise.

1.1.6 Responsibilities and undertaking

The proponents financed the entire process such as all logistical costs relating to the assignment including site visits, public participation, transportation, printing of the report and photocopying of the approved drawings among others. The proponents through his architect provided the project approved drawings and the project site plan showing access roads, service lines and buildings layout plans.

The output from the consultant includes the following:-

i. An EIA study report comprising of an executive summary, project approach, baseline conditions, anticipated impacts and proposed mitigation measures,
ii. An EMP outline that also forms part of the report recommendations.

1.1.7 Methodology outline

Since the proposed site is located within an area with no rich natural resources whose total effect to the surroundings could not be adverse and noting that the proposed project area is generally semi arid, an environmental study report would be seen to be adequate. The general steps followed during the assessment were as follows:

i. Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule 2 of EMCA, 1999
ii. Environmental scoping that provided the key environmental issues
iii. Desk Stop studies and interviews
iv. Physical inspection of the site and surrounding areas
v. Public participation by the use of questionnaires
vi. Reporting.

1.1.7.1 Environmental screening

This step was applied to determine whether an environmental impact assessment was required and what level of assessment was necessary. This was done in reference to requirements of the EMCA, 1999, and specifically the second schedule. Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

1.1.7.2 Environmental scoping

The scoping process helped narrow down onto the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, natural/ecological and social, economic and cultural aspects.

1.1.7.3 Desktop project

This included documentary review on the nature of the proposed activities, project documents, designs policy and legislative framework as well as the environmental setting of the area among others. It also included discussions with Sacco managers and design team, Sacco members who shall be the ultimate beneficiaries as well as interviews with neighbours.

1.1.7.4 Site assessment and public participation

Field visits were meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts. To ensure adequate public participation in the EIA study process, questionnaires were administered to the residents of the project area and the information gathered was subsequently incorporated into the EIA project report.

1.1.7.5 Reporting

In addition to constant briefing of the client, this EIA study report was prepared and submitted to NEMA as required by law.

2 DESCRIPTION OF THE PROJECT

2.1 Location and size of the project

The proposed project site is located within Katani Sub Location, Muthwani ward, Mavoko constituency. The proposed site neighbors St. Joseph's Integrated Primary School and Shangilia Baba na Mama Micro-intervention programme merry go round loan housing scheme (now abandoned), Divine Word Boys High School and Katani West Seventh day Adventist church, among others

The proposed site (Mavoko Town Block 2/19052) measures approximately 4.047Ha in size and is owned by Lancet Housing Cooperative Society Limited a Sacco that is comprised of employees of lancet limited.

Shangilia Baba na Mama Micro-intervention programme merry go round loan housing scheme

2.2 Objectives of the project

The proponents Lancet Housing Cooperative Society Limited whose membership is drawn from Pathologists Lancet Kenya employees are constructing this project first to provide better, quality and modern housing for its members in a secure and controlled

environment and second as a business venture as remaining houses shall be sold out after every Sacco member has been allocated a house. The proponents are shall also create additional employment opportunities to the locals.

2.3 Design specifications of the proposed project

In general, the design of the project will tend to essentially optimise the use of best available technology to prevent or minimize potentially significant environmental impacts associated with the project and to incorporate efficient operational controls together with trained staff, to ensure high level business and environmental performances.

The proposed project shall be a mixed development of both flats of two storeyed and mansionettes. The entire project shall have a total of one hundred and ninety (190) units of two, three and four bedroomed type plus a commercial centre and kindergarten.

2.3.1 Mansionettes

The proponents have proposed to construct a total of one hundred and six (106No.) mansionettes of four bedrooms each. Each of the mansionettes shall have the following features:

Ground floor

- ✓ Lounge
- ✓ Dining area
- ✓ Entrance lobby
- ✓ Guest bedroom
- ✓ Fitted kitchen
- ✓ Utility area
- ✓ Common washroom
- ✓ Domestic servant quarter
- ✓ Staircase
- ✓ Two parking spaces

First floor

- ✓ Master ensuite bedroom
- ✓ Bedroom one and two
- ✓ Common washroom for the two bedroom users
- ✓ Lobby

2.3.2 Apartments

The proposed project shall have a total of eighty four (84) apartments that shall be housed in fourteen apartment blocks. All the blocks shall be of two storeyed and shall be constructed next to the main entrance. They shall be of two bedroomed (12No) and three bedroomed master ensuite (72No.) types. Below is the site plan for the proposed project showing location of both house types.

Proposed project site plan

2.3.3 Additional amenities as proposed

The design has provided the following various amenities that shall be required by the residents within the village:

2.3.3.1 Commercial Centre

The projects commercial centre shall be positioned next to the main entrance and shall provide the following facilities that shall be common to all residents:

- ✓ Gym
- ✓ Mini market
- ✓ Club house housing a bar and restaurant
- ✓ Clinic
- ✓ Pharmacy

2.3.3.2 Kindergarten

For the sake of the young kids within the Lancet Village and considering the distances between the site and the nearest early childhood institution, the proponents have provided for a kindergarten within the site. This shall be constructed to modern standards and fully equipped with playing facilities for the young ones.

2.3.3.3 Boundary wall and CCTV

To enhance maximum security within the project area, the proponents have proposed to make the proposed project a gated community project with a boundary wall surrounding the entire ten acres and reinforced with and electric fence on top instead of a razor wire. The contractor shall begin construction activities with a boundary wall and once complete shall then move to the phase one of the project.

The proponents have also proposed provision of CCTV cameras at the project site especially along the main boundary wall and at the entrance to the Lancet village to help enhance security through proper monitoring of intruders.

2.3.3.4 Borehole

Considering the fact that the proposed project is located with a semi arid landscape with no piped water that can adequately be supplied to the project, the proponents have proposed that they shall sink a borehole on site to ensure efficient and adequate supply to the residents. The proponents shall provide water storage tanks to which water shall be pumped from the borehole before supplying into the houses mainly by gravity.

However, the proponents must ensure all necessary approvals and licenses such as WARMA and NEMA have been obtained before sinking of the borehole is done.

2.3.3.5 Backup generator

To ensure efficient and around the clock supply of power to the household, the proponents have proposed to provide a backup generator that shall automatically go on in the event that there is a power blackout.

2.3.3.6 Landscaped gardens and driveways

To enhance the aesthetic quality of the proposed Lancet Village, the proponents have proposed provision of extensive landscaped flower gardens that shall be located along the common driveways. These shall be promptly irrigated using the water recycled from the waste water treatment plant and properly tendered for.

The proponents have also to provide cabro paved drive ways to enhance easy movement while within the proposed project site as shown in the site plan above. For proper maintenance and cleaning of the landscaped gardens and driveways respectively, the residents shall be required to pay a small service charge that shall be paid as salaries to cleaners and gardeners who shall be offering the services.

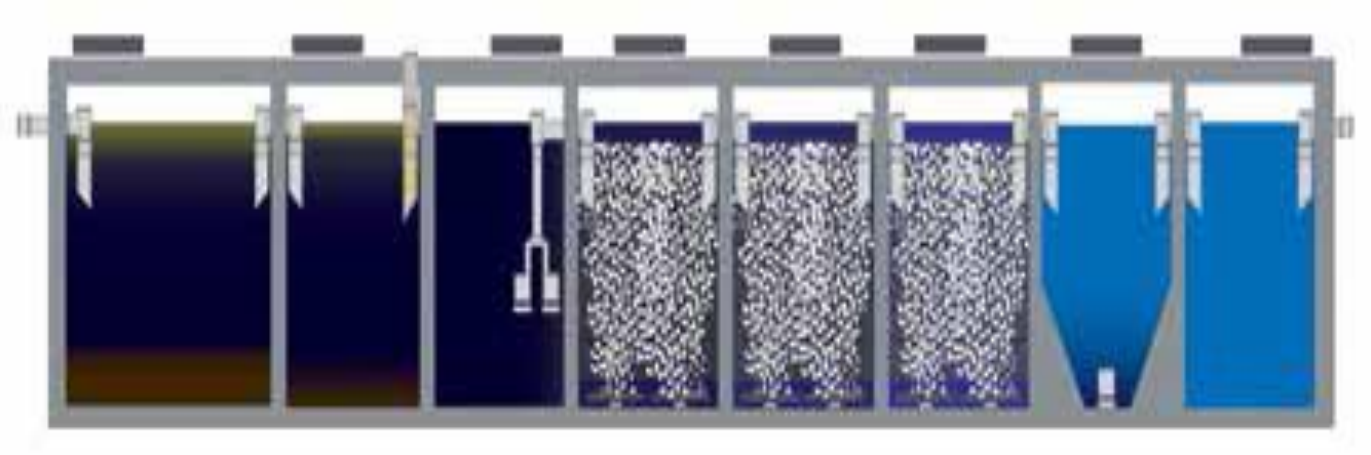
2.3.3.7 Waste water management

The proposed project site is located in an area that does not have an operational/existing sewer line therefore the proponents need to provide an efficient, effective and reliable means of managing all the waste water generated

from the proposed project. To this effect, the proponents have proposed provision of a common waste water management system sourced from ***BioBox Limited***; a company licensed by NEMA to provide one of the advanced technologies referred to as ***Enpura UG & Pro System***. This technology meets at surpasses the minimum required effluent standards locally and internationally and has the following additional advantages:

- ✓ Clear, Odourless Treated Effluent Ideal for irrigation. Cuts water costs and usage by up to half. Meets and exceeds NEMA discharge standards.
- ✓ Low Sludge Wasting Frequencies No need for expensive exhaustion services at regular intervals.
- ✓ Highly Stable Fixed Film Media Technology Highly tolerant of shock loads.
- ✓ Low Maintenance & Operating Costs Economical to maintain and no dedicated operator required.
- ✓ Modular Configuration Can be sized for 50 - 2,000 persons. Easily expandable to upgrade the system capacity as demand increases
- ✓ Above Ground or Below Ground Option Depending on your site conditions, we have a solution for you.

The following is an illustration and write up of how the system works:



Steps 1 2 3 4 5 6

Step 1

The waste water (both black and grey) from the facility are gravity fed of pumped into the Primary Treatment Tank.

Step 2

The liquid effluent then passes through a brush filter to the second tank of the Primary Treatment to ensure that no solids enter the reactors. The waste water is then gravity-fed into the Buffer Chamber.

Step 3

The Buffer Chamber regulates the amount of effluent that is fed into the Reactor Tanks. The plant runs at a maximum efficiency when the effluent stream is at a steady, constant rate in a twenty-four hour period ensuring the most effective treatment.

Step 4

Inside the Reactors, millions of tiny bacteria lodge onto the fixed film media. The organisms grow, living on the nutrients present in the waste water and through the introduction of the correct volume of oxygen.

Step 5

The effluent then passes into the Clarifier where the sludge settles at the bottom and the clear water separates at the top. The accumulated sludge at the bottom of the clarifier is recycled back into the Primary Treatment Tank to aid in digestion

Step 6

The final product is a clear and odourless effluent ready for discharge either by means of irrigation or returning it to the environment.

nema
mazingira yetu | uhai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

Tel: (254-020)-6005522 / 3 / 6 / 7, 6001945, 6008767
Mobile line: 0724 253 398, 0723 363 010, 0735 013 046, 0735 010 237
Telkom Wireless: 020-2101370
Fax: (254-020)-6008997
Hotline: 020-8077233, 020-6006041

P. O. Box 67839 - 00200
Popo Road, Nairobi, Kenya
E-mail: dgnema@nema.go.ke
website: www.nema.go.ke

NEMA/ WQ/ETS/VOL.1/0036 **9TH *FEBRUARY, 2015***

BIOBOX KENYA LTD.
P.O BOX 400 - 00502
NAIROBI

RE: WASTE WATER TREATMENT TECHNOLOGIES

The National Environment Management Authority (NEMA) is in receipt of information on waste water technologies for your company.

The water quality section of the Authority has created an inventory of all waste water treatment technologies available locally. The inventory and their brochures are available at the Water Quality Section. Note that the Authority does not approve wastewater treatment technologies but analyses the performance of the technologies through quarterly effluent reports submitted during the license application process as per the 3rd schedule of the Water Quality Regulations of 2006.

We confirm that **Biobox Kenya Ltd.** wastewater treatment technologies are listed in the above inventory. While NEMA has no objection to the application of the wastewater treatment technologies, the Authority advises clients to consult their environmental experts or engineers on the size, type and performance characteristics of the chosen technology. Furthermore you are required to comply with statutory requirements of other relevant government agencies.

We look forward to future collaboration in making our environment better.

DAVID KODIA
For: DIRECTOR GENERAL

2.3.3.8 Swimming pool

Next to the commercial centre, the proponents have proposed to construct a communal swimming pool that shall be shared among the residents of the Lancet Village.

2.3.3.9 Solid waste management

Solid waste management within the project area is normally an individual responsibility to ensure that all the solid waste generated within their households is properly disposed. It's for this reason that the proponents shall be engaging a private service provider who is NEMA compliant (licensed to transport solid waste) to offer his/her services to the residents of the Lancet Village in Katani. The proponents shall surcharge the residents as part of the service charge a small fee that shall also be extended towards payment of such services.

2.3.3.10 Storm water management

The proposed project area is a fairly flat area hence storm water does not drain properly as required when it rains. It is for this reason that the proponents have proposed to engage the services of a civil engineer to assist in designing and construction a nice drainage system that shall freely drain the waters whenever it rains. All the driveways across the village shall be tilted at some angle to enable free flow of storm water away from the residential area hence avoiding any chances of flooding within the village.

2.4 Description of the project's construction activities

2.4.1 Pre-construction investigations

The implementation of the project's design and construction phase will start with thorough investigation of the site soil chemical and physical properties and water table level determination.

2.4.2 Building materials

Greater emphasis shall be laid on procurement of building materials which shall strictly be done within the project area and its environs, which will make both economic and environmental sense as it will reduce negative impacts of transportation of the materials to the project site through reduced distance of travel. To avoid much wastage of construction materials, the proponents shall be ordering the materials in quotas as at when they are required and the quantities required. The proposed project construction activities shall require quarry blocks, sand, cement, ballast, steel metals, cabro, roofing materials among others.

2.4.3 Excavation and foundation works

The proposed project site is located in an area characterized by black cotton soils that are usually not stable for foundation works. The proponents shall carry out extensive excavation activities to ensure a stable foundation to the buildings hence avoiding future calamities such as collapsing of the buildings. Excavation activities shall cause considerable levels of disturbance to the project area and must be limited to day time only. No blasting of stones shall be carried out at the project site. The proponents must ensure that all the excavated soils are properly disposed off away from the construction site preferably areas approved by the county government to avoid reducing the aesthetic quality of the areas off site.

2.4.4 Masonry, concrete works and related activities

Construction of the masonry walls, foundations, floors, pavements, storm water drainage systems, perimeter fence, footpaths, roads and parking areas 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, erection of building walls and curing of fresh concrete surfaces. These activities are known to be labour intensive and shall be supplemented by machinery such as concrete mixers.

2.4.5 Electrical work

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

2.4.6 Landscaping

On completion of the project, massive landscaping shall be carried out across the project area especially along all the drive ways and all the common areas of the project site. Different types of trees and flowers shall be planted within the village to help improve the aesthetic quality. Watering of the gardens shall be done twice daily to using the water recycled from the waste water management system that shall be installed within the village.

2.4.7 Project Budget

The total cost of the proposed project is Kshs 800,000,000.00. This amount will be distributed to various project activities that include; builders work, electrical services installations, mechanical service installations, external works, waste water management systems, storm water drainage systems, site installations, preliminaries and contingencies.

2.5 Description of the Project's Operational Activities

2.5.1 Residence

At least one hundred ninety families shall be residing within the project area soon after all construction activities are complete. Assuming within each house shall be housing about five people, once this project is complete and fully occupied, there shall be at least nine hundred people at the village. This shall contribute to the increase of the area's population hence the proponents need to provide reliable basic services within the village.

2.5.2 Solid waste

Considering that the county government does not provide solid waste management services, the proponents have proposed to contract a private service provider licensed by

both NEMA and the county government to help manage all the solid waste generated from the residents. Each house shall be provided with a solid waste collection bin and all the solid waste generated/collected shall be picked twice a week for disposal at designated points. The proponents shall also provide common solid waste collection bins along the drive way and all common areas for proper collection. A common collection cubicle shall also be provided at the commercial centre, kindergarten and swimming pool area which shall be emptied twice a week.

2.5.3 Waste water management

All the waste water generated by the residents of the village shall be recycled through the waste water management system that shall be provided and reused to irrigate the landscaped gardens and in cleaning all the common areas. The proponents must ensure all houses are properly connected to the system and ensure any effluent to the environment is reduced to harmless states before discharge. The proponents must however apply for a waste water discharge licence if they shall be discharging the waste water into the environment.

2.5.4 Cleaning

The proponents will be responsible for ensuring regular washing and cleaning of the entire estate especially the footpaths, roads, shopping complex, staircases, storm water drainage systems pavements among other commonly shared amenities and the individual residents will be responsible for cleaning their own units. This shall be done with a view to protect the residents from various diseases brought about as a result of the dirty accumulated within the estate that might be home for disease causing micro-organisms.

2.6 Description of the project's decommissioning activities

2.6.1 Demolition works

Upon decommissioning, the project components including buildings, roads, footpaths, drainage systems, parking areas and boundary wall will be demolished. This will produce a lot of solid waste mostly construction debris, which will be reused for other

construction works or if not reusable, disposed of appropriately by a licensed waste disposal company.

2.6.2 Dismantling of equipment and fixtures

All equipment including electrical installations, furniture, finishing fixtures partitions, pipe-work and sinks among others will be dismantled and removed from the site on decommissioning of the project. Priority will be given to reuse of these equipment in other projects. This will be achieved through resale of the equipment to other building owners or contractors or donation of these equipments to schools, churches and charitable institutions.

2.6.3 Site restoration

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

3 BASELINE INFORMATION

Introduction

Mavoko Sub County formerly Mavoko Municipal Council is one of the oldest former councils in the Country with its evolution dating back to 1940, when it began as Local Native Council (LNC) then became an African District Council (ADC). It became an Urban Council, curved from the County Council of Masaku in 1974 and got upgraded to a Town Council in 1987 and to a Municipal Council status in 1993 and later Mavoko Sub County under the new constitution forming part of Machakos County. It covers an area of 693KM², with an average population of 200,000. The Sub County like several others within Machakos, Kiambu and Kajiado counties acts as a dormitory town for people working within Nairobi City County and other nearby growing centers.

Most of the population is hosted at the Sub County's satellite towns of Mlolongo, Athi River and Kyumvi. Mavoko Sub County has many factories such as East African Portland Cement, Bamburi Cement, Mombasa cement, Nyumbani Cement Factory, Kapa Oil Refinery, Export Processing Zone, Nation Media, Mastermind Tobacco, Mabati Rolling Mills, Devki Steel Works Company, Sun-Rose and Primarosa flower companies among others. In total there are over sixty factories located within the sub county's jurisdiction creating enormous wealth to the county and several employment opportunities to the residents of the county. Previously, Mavoko as an area was largely seen as an industrial zone owing to the several factories that have opened shop there, but this has gradually been rivaled by the enormous real estate projects that have sprung in the area. Several residential estates can be seen coming up both single dwelling and multi dwelling residential units that act as home for several city residents/workers.

3.1 Proposed Site & Zone Character

The land parcel earmarked for development of proposed project is a Greenfield land within Katani. Katani is a pristine low density residential zone characterized by affluent residential developments whose occupancy inclines to single and multi - family houses suited inform of bungalows and maisonettes. Compared to other developments within the neighbourhood, specifically land parcels on the opposite side of Mombasa road where market forces of demand and supply determine the kind of developments coming up

mainly high density multi-family units/high rise flats, Senior's depicts serenity– bungalows and maisonettes profile the project area. The latter hosts high and upper middle income earners. Construction of proposed project is informed by this conventional development trend currently taking shape within the project area

3.2 Physical Environment

3.2.1 Climate

The county is generally hot and dry. It has two rainy seasons, the long and the short rain seasons. The long rains seasons starts at the end of March and continues up to May, while the short rains season starts at the end of October and lasts till December. The annual average rainfall ranges between 500mm to 1300mm. There are significant regional and seasonal variations within the county and rainfall reliability is quite low. The high altitude areas of Matungulu, Kangundo, Kathiani, Central and Mwala divisions receive slightly higher rainfall than the low land areas. Mean monthly temperatures vary between 18^0C and 25^0C. The coldest month is July while October and March are the hottest. The highland areas which receive higher rainfall are more suitable for rain-fed agriculture than the lowland areas, while the plains support ranching.

The project area falls within an area classified as lowland and therefore receives little rainfall throughout the year this warrants the need for setting up irrigation systems to maintain envisaged greenery within the project site.

3.2.2 Topography and Drainage

The county has a variety of topographical features. The landscape is largely a plateau that rises from 700m to 1700 m above sea level and is interrupted by an escarpment and a series of hill masses, the highest of which is Kilimambogo or Ol Donyo Sabuk, which rises to 2,144m above sea level. The county is bound in the western part by the Kapiti and Athi Plains, in the north by the Athi River which curves round the solitary hill of Ol Donyo Sabuk to flow to the south east. Rising steeply to the north east of Athi River is the Yatta Plateau, which is broken by occasional hills. This plateau extends into the basin of River Tana. In the central part of the county is a striking series of hill masses that

stretch in a roughly north-south axis. This series includes the Ol Donyo Sabuk, Kanzalu ranges, Kangundo, Mua, Mitaboni, Iveti and Kiima Kimwe.

At a localized level, the project area is generally flat, gently sloping towards Mombasa road. This offers ample grounds for construction works. A spatial analysis of the neighbourhood landscape depicts low undulating topography with minor depressions. From the foregoing slope analysis, constructions of the proposed residential buildings will not require extensive levelling works as the slope difference is minimal and unrestrictive to construction works. In addition, light levelling and backfilling works would be required to maintain the natural gradient onsite to enhance storm water flow towards Mombasa road drainage systems.

3.2.3 Soils

The project area has loamy and black cotton soils. These soils have no uniform load bearing capacities. This would necessitate excavations of the soils to relatively longer depth to create a structurally amble foundation base to support construction of proposed storied buildings. Nonetheless these soils are fertile and can therefore support numerous forms of plants making them ideal for landscaping purposes.

3.3 Flora and Fauna

Altitude, rainfall, soils and rivers influence vegetation in Machakos County. This description is based on physiographic characteristics i.e. growth form and vegetation cover. The types include: Forest Types (Hilltop); more than 10m tall and has interlocking cover of between 80-100%, Woodlands; The trees are usually 10-20M tall with a canopy of between 50-79% and a well developed herbaceous cover of dwarf shrub understory, Bushland and Shrubland; the trees are 6-10M tall with crowns that form a canopy of 20-49% and scattered but conspicuous and Dwarf Shrub grasslands; the vegetation consists of woody plants of less than 1.0M tall and a canopy cover of 3-19%. The vegetation type is common in Athi River, Central and some parts of Masinga and the project area as well.

The proposed site, falls within a semi-arid settled zone, with low density housing and as such the habitats of project area and its surroundings have been highly disturbed and

modified. Other areas that are not built up are dominated by dry grass and bear ground. The proposed project site is covered with dry grass and patches of bear ground. Only the affected area shall be cleared to allow for the development. There are no threatened animal or plant species within the site or its immediate area of influence and as such, it is not anticipated that the proposed residential estate site will have a significant impact on the surrounding area biodiversity. However, some obstruction to flying fauna may be experienced

3.4 Socio-Economic Environment

Administratively, Katani falls within the jurisdiction of Mavoko Sub County, Machakos County. Mavoko Sub County falls to the east of Nairobi. It encompasses some of Nairobi city dormitory centers such as Mlolongo, Athi River and Lukenya. It's worth noting that high land prices within Nairobi city compelled most residents to seek better alternatives in areas close to Nairobi. Syokimau and Katani towns offer such convenience. The town and its catchment area including the project area enjoy close commuter distance to the city. This metropolitan convenience has enticed great investments. Large tracts of agricultural land have been subdivided to pave way for real estate investments. In the last ten years booming real estate sector within Mavoko Sub County has occasioned fast and unpredicted growth that has translated to unplanned settlements. Consequently, the pace and rate of growth has outstripped levels of service provision. Areas that provide residence to majority of the resident population have no;

- Public sewerage mains
- Piped water network
- Adequate social amenities
- Planned and well structured zoning plans
- Social infrastructure to cater for urban community systems

This transformation has over time led to degradation of neighbourhoods and standards of living. Indeed, land parcels closer to Mombasa and Namanga roads within a commuter distance to the city hitherto quiet low density settlements have in the recent past especially after commissioning of Namanga road been upgraded to high density settlements that foster high interactions. This mainly because little or no reference at all

was made to the control units that should accompany dormitory town growth and development. The major economic investment within Mavoko Sub County includes real estate and industrial activities with several companies opening their manufacturing plants within the sub county.

3.5 Population

The County covers 6,208 km^2 and has a population of 1,098,584 as per 2009 census(Male – 49 %,Female – 51 %); with an age distribution of 0 to 14 years at 39%, 15 to 64 years 56% and 5% above 65 years-break down this age distribution more (0-14, 15-29, 30-64 and over 64). Its population annual Growth Rate is 1.7 % with a current estimate of 264,500 households of which only 17% accessing electricity. Its capital town Machakos is cosmopolitan and is located 64kilometres southeast of Nairobi. The poverty levels in the County are at 59.6 % against a national average of 47.2% based on KIHBS (2009); this positions the County at 33 out of the 47 counties, while 52% of the population lives in the urban centers, which is way above the national average of 29.9%. There is a high increase in labour force which has led to increase in unemployment and this could lead to escalation of crimes as a result of non-absorption of this active population in services of gainful employment. All this factors combine to create a robust township in terms of settlement and other urban related services.

The project area falls within Mavoko Sub County which is a populous part of the county. This high population can be attributed to the proximity of the sub county to Nairobi as most of the people work in Nairobi and reside in the sub county. In existing industries within the sub county also attract more labour force.

The proposed project is expected to bring with it modest population increase within the zone during and after construction. A project of this scale is bound to take up more than one hundred workers of which about twenty will constitute experts in various field within the built environment industry with the rest mainly consisting of manual casual workers. Since construction works are envisaged to take about three years and finishes another six calendar months, this pool of labour is expected to be present during this period transforming the otherwise quiet neighbourhood to a rather active zone. On the other

hand completion of the construction face will usher in the occupation phase. Once all the housing units are occupied, the project will inject an extra one hundred and ninety households. This additional resident population will engage in activities that would cumulatively require adequate supply of various goods and services. This will bring with it increased economic opportunities and pressure on various amenities within the area.

From the foregoing its apparent that Mavoko Sub County should institute effective urban planning to guide and control developments such as the proposed multi-family developments to avoid strain on the physical amenities from growth of informal settlements. In addition, community policing should be enhanced to reduce insecurity. Also, subsequent subdivision should set apart land for expansion of service infrastructure and development of social amenities like school, health centres etc.

3.6 Infrastructural Services

3.6.1 Access

The plot is bound by Syokimau Katani road. The proactive site plan for the proposed development provides a common six metre wide cabro paved road from which all units shall accessed from. The village has two gates one main and the other being an emergency gate. Each maisonette/apartment unit shall have two parking bays at the frontage. Green spaces would be provided between the parking spaces so that a concrete-free environment is perceived by the prospective occupiers and commuters to the development. This will also benefit in promoting an atmosphere of tranquillity. The aim is also to enhance the aesthetic quality of the project area that would ultimately result into a "feel good" environment.

The anticipated additional traffic occasioned by the proposed development will not critically affect the traffic flow in the access road since it is usually not very busy.

3.6.2 Water

The proposed project area does not have piped water though it is the responsibility of the county government to provide such service. Most residents depend mostly on borehole

water which they source from the few available boreholes that supply water communally. Other sources of water supply within the project area include vendors who supply with tankers.

3.6.3 Sewer system

The proposed project area does not have an operational sewer system and this therefore limits most home owners/residents to over dependency on septic tank technology in the management of waste water generated from their houses. A drive through the proposed project area one can easily notice a number of exhausters which is evidence enough that septic tanks are the main methods of waste water management in the project area. To facilitate proper waste water management ensuing from proposed housing units, the proponents shall install a more advanced facility that shall be allowing for recycling of the waste water which shall be reused within the project area.

3.6. 4 Electricity

Electric power demand within the centre is met by KPLC through the national grid. According to information sought from KPLC office Machakos, projected electrical power demand occasioned by proposed hill view estate (Phase IV) shall be met by existing power mains serving other developments in the neighbourhood. To this end, the proponents shall to apply to KPLC to be connected to the national grid.

4.0 RELEVANT LEGISLATIVE AND REGULATORY FRAMEWORK

4.1 Introduction

There is a growing concern in Kenya and at global level that many forms of development activities cause damage to the environment. Development activities have the potential to damage the natural resources upon which the economies are based. A major national challenge today is how to maintain sustainable development without damaging the environment. The Environmental Impact Assessment is a useful tool for protection of the environment from the negative effects of development activities. It is now accepted that development projects must be economically viable, socially acceptable and environmentally sound. It is a condition of the Kenya Government to conduct Environmental Impact Assessment on the development projects.

According to Sections 58 and 138 of the Environmental Management and Coordination Act (EMCA) No. 8 of 1999 and Section 3 of the Environmental (Impact Assessment and Audit) Regulations 2003 (Legal No. 101), buildings complexes require an Environmental Impact Assessment study reportprepared and submitted to the National Environment Management Authority (NEMA) for review and eventual Licensing before the development commences. This was necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development without interfering with the environment.

4.2 Environmental Legal Framework

Environmental Management and Co-ordination Act No. 8 of 1999, provide a legal and institutional framework for the management of the environmental related matters. It is the framework law on environment, which was enacted on the 14th of January 1999 and commenced in January 2002. Topmost in the administration of EMCA is National Environment Council (NEC), which formulates policies, set goals, and promotes environmental protection programmes. The implementing organ is National Environment Management Authority (NEMA). EMCA comprises of the parts covering all aspects of the environment.

Part VIII, section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. Section 73 requires that operators of projects, which discharge effluent or other pollutants, submit to NEMA accurate information about the quantities and quality of the effluent. Section 74 demands that all effluent generated from point sources are discharged only into the existing sewages system upon issuance of prescribed permit from the county governments.

4.2.1 Public Health Act (Cap. 242)

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

Such nuisance or conditions are defined under section 118 as waste pipes, sewers, drainers or refuse pits in such state, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to health. Any noxious matter or waste water flowing or discharged from any premises into the public street or into the gutter or side channel or watercourse, irrigation channel, or bed not approved for discharge is also deemed as nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

On responsibility of the County governments Part XI, section 129, of the Act states in part "It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes.

Section 130 provides for making and imposing regulations by the county governments and others the duty of enforcing rules in respect of prohibiting use of water supply or

erection of structures draining filth or noxious matter into water supply as mentioned in section 129. This provision is supplemented by section 126A that requires county governments to develop by laws for controlling and regulating among others private sewers, communication between drains and sewers and between sewers as well as regulating sanitary conveniences in connection to buildings, drainage, cesspools, etc. for reception or disposal of foul matter.

The contractor/proponents shall provide adequate and well maintained sanitary facilities for use during the project construction phase as required by law. They shall also provide adequate solid waste collection containers to help gather solid waste generated during this phase before disposal is done through a licensed solid waste transporter will also be contracted to offer such services.

4.2.2 County Government and Planning Powers

Machakos County Government has the statutory mandate to undertake development planning and control land and building development within its area of jurisdiction. Particular reference is made to the County Government Act (2012), urban areas and Cities Act, 2012 and the Physical Planning Act (Cap 286).

4.2.2.1 The County Government Act (Cap. 265)

Section 109 helps counties to ensure effective co-ordination of spatial developments. Subsection (2) part C states in part; a spatial county plan shall;

i) Indicate desired patterns of land use within the county;
ii) Address the spatial construction or reconstruction of the county;
iii) Provide strategic guidance in respect of the location and nature of development within the county
iv) Set out basic guidelines for a land use management system in the county taking into account any guidelines, regulations or laws as provided for under Article 67(2) (h) of the Constitution;
v) Set out a capital investment framework for the county's development programs;
vi) Contain a strategic assessment of the environmental impact of the spatial development framework;

4.2.2.2 The Physical Planning Act (Cap. 286)

The Physical Planning Act (Cap.286), aimed at developing a sound spatial framework for co-existence, through plan proposals that enhance and promote integrated spatial/physical development of socio-economic activities. According to Section 29, subject to the provisions of this Act, each county government shall have power:

- ✓ To prohibit or control the use and development of land and buildings in the interest of proper and orderly development of its area.
- ✓ To consider and approve all development applications and grant all development permissions
- ✓ To ensure the proper execution and implementation of approved physical development plans;
- ✓ To formulate by-laws to regulate zoning in respect of use and density of development.

Section 30 (1): No person shall carry out development within the area of a County Government without development permission granted by the said County Government.

Section 31 (1): Any person requiring development permission shall make an application in the form prescribed in the Fourth Schedule, to the county administrator of the sub county responsible for the area in which the land concerned is situated.

Section 31 (2): The application shall be accompanied by such plans and particulars as are necessary to indicate the purposes of the development, and particularly shall show how the proposed use and density, and the land which the applicant intends to surrender for purposes of principal and secondary means of access to any sub-divisions within the area included in the application and to adjoining land.

Section 33 (1): Subject to such comments as the director may make on a development application referred to him under Section 32, a County Government may in respect of such development application:

- ✓ Grant the applicant a development permission in the form prescribed in the Fifth Schedule, with or without conditions;

- ✓ Refuse to grant the applicant such development permission stating the grounds of refusal.

According to Section 33 of the Physical Planning (Building and Development Control) Regulations (1998), the Director of Physical Planning shall refuse to recommend any new building or proposed development, or alteration or addition to any existing building if:

- ✓ The proposal is not in conformity with the approved development plan.
- ✓ Such plans disclose a contravention of the physical planning (Building and Development) rules.
- ✓ The plans are not correctly drawn or omit to show information required.
- ✓ On such being required, a separate application accompanied by sets of such plans has not been lodged in respect of buildings on separate plots or subplots.
- ✓ The land or the proposed building or structure is not used for any purpose which might be calculated to depreciate the value of the neighbouring property or interfere with convenience or comfort of neighbouring occupants
- ✓ The proposed building or land use is unsuitable, injurious to amenities or detrimental in respect of appearance or dignity or fails to comply with physical planning requirements in regard to sitting, design, height, elevation, size, shape, structure or appearance.
- ✓ The building is not sited in a satisfactory position.
- ✓ The system of drainage, including soil, waste and surface water of the plot, or subplot upon which the building is to or stand, is not satisfactory.
- ✓ Provision has not been made for adequate natural light and ventilation, or
- ✓ Any other physical planning issue

4.2.3 The Building Code

In recognition of the role of the county governments as lead planning agencies, the adoptive bylaw compels any potential developer to submit development application for approval. The county governments are hence empowered to disapprove any plan submitted if the plan is not correctly drawn or do not provide sufficient information that complies with the by-law.

Any developer, who intends to erect a building such as the proposed project, must give the concerned county government a notice of inspection, before the erection of the structure. After erecting the building, a notice of completion shall be issued to the county government to facilitate final inspection/approval. No person shall therefore occupy a building whose certificate of completion has not been issued by the county government. As a precaution against fire breakout, the by-law states that the walls of any premise shall be non-combustible throughout, similarly, in every building, other than a small house which comprises more than one storey shall have fire resistance.

The by-law, in Section 214 indicates that in any public building where the floor is more than 20 feet above the ground level, the county government may recommend the provision of fire fighting equipment that may include one or more of the following:

- ✓ Hydrants, hose reels and fire appliances
- ✓ External conations
- ✓ Portable fire appliances
- ✓ Water storage tanks
- ✓ Dry risers
- ✓ Sprinkler, drencher and water spray spring protector system

According to Section 34, liquids with a flash point 230c such as petrol shall not be permitted on premises used for purpose of public assembly, except:

(a) A quantity not exceeding two pints kept in approved container with a screwed cap,

(b) A quantity of not more than half pint in a container filled with absorbent material for use in connection with an internal combustion engine on the stage.

Finally, Section 196 underscores that a county government may refuse to admit into a sewer any trade waste, or other effluent unless it has been treated in approved manner. In this regard, a county government may cause the occupier of the premise may be compelled to construct an approved manhole connected to the pipe conveying such effluent.

4.2.3 Sessional Paper No 6 of 1999 on Environment and Development

The policy paper emphasized environmental impact assessments must be undertaken by developers as an integral part of a project's preparation. It also proposed for annual environmental auditing to investigate if the developer is fully mitigating the impacts identified in the assessment report.

4.2.4 Institutional Framework

The Environmental Impact Assessment for the proposed development is bound to be influenced by the operational interests of several lead agencies, whether exclusively or concurrently. These include, but not limited to the following key institutions:

(i) The Respective County Government

County governments have the statutory mandate to undertake development planning and control land and building development in their respective jurisdictions. Particular reference is made to the County Government Act (2012), urban areas and cities Act (2012) and the Physical Planning Act (Cap 286).

Section 109 of the County Government Act (2012) helps counties to ensure effective co-ordination of spatial developments. Subsection (2) part C states in part; a spatial county plan shall;

- ✓ Indicate desired patterns of land use within the county;
- ✓ Address the spatial construction or reconstruction of the county;
- ✓ Provide strategic guidance in respect of the location and nature of development within the county
- ✓ set out basic guidelines for a land use management system in the county taking into account any guidelines, regulations or laws as provided for under Article 67(2) (h) of the Constitution;
- ✓ set out a capital investment framework for the county's development programs;
- ✓ contain a strategic assessment of the environmental impact of the spatial development framework;

Accordingly, Section 29 (a) of the Physical Planning Act has granted all county governments in Kenya, the County government of Machakos being no exception, the power to prohibit or control the use and development of land and buildings.

(ii) National Environment Management Authority (NEMA)

In 2002 the government established NEMA as the supreme regulatory and advisory body on environmental management activities being undertaken by statutory organs with a view to promoting their integration into development policies, programmes, plans and projects that provide sustainable development and a safe and healthy environment to all Kenyans. The key functions of NEMA through the National Environment County government include:

- ✓ Responsibility for policy formulation and direction for the purposes of the Act;
- ✓ Setting national goals and objectives and determining policies and priorities for the protection of the environment;
- ✓ Promotion of cooperation among public departments, county governments, private sector, non-governmental organizations and such other organizations engaged in environmental protection programmes; and
- ✓ Perform such other functions as are assigned by the Act.

The Authority will remain in charge of coordinating all activities related to environmental management in the project area, such as the enforcement of EIAs, as well as EAs.

(iii) The Director of Physical Planning

The Physical Planning Act (Cap 286) established the office of the Director of Physical Planning. The duties of the Director of Physical Planning shall include the following:

- ✓ Formulate national, regional and local physical development policies, guidelines and strategies.
- ✓ Be responsible for the preparation of all regional, local and national physical development plans.
- ✓ From time to time, initiate, undertake or direct studies and research into matters concerning physical planning.

- ✓ Advise the Commissioner of Lands and County Governments on the most appropriate use of land including land management such as change of user, extension of user, extension of leases, subdivision of land, and amalgamation of land, and
- ✓ Require County Governments to ensure proper execution of physical development control and preservation of orders.

4.2.5 Physical Planning Act, 1999

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

Section 30 states that any person who carries out development without development permission will be required to restore the land to its original condition. It also states that no other licensing authority shall grant license for commercial or industrial use or occupation of any building without a development permission granted by the respective local authority. ***All the building plans i.e. both architectural and structural have been approved from the county government of Machakos and have been attached to the report.***

Finally, section 36 states that if connection with a development application, local authority is of the opinion that the proposed development activity will have negative impacts on the environment, the application shall be required to submit together with the application an environment impact assessment EIA study report. EMCA, 1999 echoes the same by requiring that such a report is approved by NEMA and should be followed by annual environmental audits. ***The proponents have also complied with this provision by appointing a NEMA registered and licensed Lead Expert to conduct an environmental impact assessment study for the proposed project and subsequently submit a study report to NEMA for review and licensing.***

4.2.6 Land Planning Act (Cap. 303)

Section 9 of the subsidiary legislation (The Development and Use of Land Regulations, 1961) under this Act requires that before the county governments submit any plans to then Minister for approval, steps should be taken as may be necessary to acquire the owners of any land affected by such plans. Particulars of comments and objections made by the landowners should be submitted. This is intended to reduce conflict with the interest such as settlement and other social and economic activities.

4.2.7 Water Act, 2002

Part II, section 18, of the Water Act 2002 provides for national monitoring and information system on water resources. Following on this, sub-section 3 allows the Water Resources Management Authority (WRMA) to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by a facility operator and the information thereof furnished to the authority.

The Water Act Cap 372 vests the rights of all water to the state, and the power for the control of all body of water with the Minister, the powers is exercised through the Minister and the Director of water resources in consultation with the water catchments boards, it aims at among others:

a) Provision of conservation of water and
b) Appointment and use of water resources.

Water apportionment board is a National Authority whose duty is to advise the Minister on issues with respect to water use. Permission to extract underground water for large-scale use lies with the board and the pollution of such water source is an offence. Failure to comply with such directives is an offence.

The proponents intend to sink a borehole on site for adequate water supply to the residents. They have been advised to first seek the necessary approvals and licenses such as WARMA before any sinking is done.

Section 73 of the Act allows a person with a licence (licensee) to supply water to make regulations for the purposes of protecting against degradation of water resources. Section 75 and sub-section 1 allows the licensee to construct and maintain drains serves and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

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

The contactor shall be required to implement necessary measures to prevent any form of either ground or surface water contamination throughout the project period.

4.2.8 Building Code 1968

Section 194 requires that where sewer exists, the occupants of the nearby premises shall apply to the county government for a permit to connect to a sewer line in the event that there is an existing sewer system within the project area. The code also prohibits construction of structures or buildings on sewer lines.

Considering that the propose project site is located in an area that is not sewered, the proponents have proposed construction of a common waste water treatment plant within the site for the management of all waste water from the proposed project. This was the preferred option of waste water management since it shall allow recycling and reusing of the water within the project area for irrigating the several landscaped gardens and flushing toilets.

4.2.9 Penal Code Act (Cap.63)

Section 191 of the penal code states that if any person or institution that voluntarily corrupts or foils water for public springs or reservoirs, rendering it less fit for its

ordinary use is guilty of an offence. Section 192 of the same Act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution is dwelling or business premises in the neighbourhood or those passing along public way, commit an offence.

The proponents shall be required to ensure strict adherence to the Environmental Management Plan provided in the report throughout the project cycle in order to mitigate against any possible negative impacts to the environment. Monthly and quarterly monitoring on the level of implementation of the provisions of the EMP shall be carried out and further mitigation measures given in case of any negative impacts to the environment and its resources. The proponents are also required to comply with any improvement orders provided by any of the relevant national and county government officials and departments

4.2.10 Factories and Other Places of Work Act (Cap 514)

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

4.2.10.1 Health

The premise must be kept clean, daily removal of accumulated dust from floors, free from effluents arising from any drain, sanitary convenience or nuisance and without prejudice to the generality of foregoing provision. A premise must not be overcrowded, there must be in each room 350 cubic feet of space for each employee, not counting space 14 feet from the floor and a 9 feet floor-roof height.

The circulation of fresh air must secure adequate ventilation of workrooms. There must be sufficient and suitable lighting in every part of the premise in which persons are working or passing. There should also be sufficient and suitable sanitary conveniences separate for each sex, must be provided subject to conformity with any standards prescribed by rules.

Provision of suitable protective clothing and appliances including where necessary, suitable gloves, footwear, gas masks, and head covering, and maintained for the use of workers in any process involving expose to wet or to any injurious or offensive substances.

4.2.10.2 Safety

Hoarding of the construction site and other dangerous parts of other machinery is mandatory. Training and supervision of inexperienced workers, protection of eyes with goggles or effective screens must be provided in certain specified processes. Floors, passages, gangways, stairs, and ladders must be soundly constructed and properly maintained and handrails must be provided for stairs.

Special precaution against gassing is laid down for work in confined spaces where persons are liable to overcome by dangerous fumes. Air receivers and fittings must be of sound construction and properly maintained. Adequate and suitable means for extinguishing fire must be provided in addition to adequate means of escape in case of fire must be provided.

4.2.10.3 Welfare

An adequate supply of both quantity and quality of wholesome drinking water must be provided. Maintenance of suitable washing facilities, accommodation for clothing not worn during working hours must be provided. Sitting facilities for all female workers whose work is done while standing should be provided to enable them take advantage of any opportunity for resting. ***The contractor/proponents shall provide all the required needs to the construction workers on site and ensure a comfortable working environment for the workers.***

Section 42 stipulates that every premise shall be provided with maintenance, readily accessible means for extinguishing fire and person trained in the correct use of such means shall be present during all working periods. ***The contractor shall provide enough fire extinguishers on site and position them strategically***

across the proposed site and train the construction workers on how to use them in case of any eventuality of a fire outbreak.

4.5.9 Solid Waste Management Legal Notice No. 121

The Environmental Management and Coordination Legal Notice No 121 on (waste management) provides for the responsibility of waste generator, cleaner production methods, segregation of waste by generator, waste transportation license, responsibility of a waste transporters, transportation of waste by licensed transporters, license for disposal facility, waste treatment by operators of disposal sites, requirement for environmental audit and re-use and recycling plants. The legal notice further provides mitigation measures to industrial wastes and their treatment. The hazardous and toxic wastes have been specified by the legal notice that also provides for various requirements of EIA study. Details on how hazardous and toxic wastes have to be handled, stored, treated, transported and even provision of permits. This has to apply to pesticides and toxic substances, biomedical wastes and radioactive wastes whereby collection, transportation, storage, treatment and disposal of them have been specified. The legal notice further specifies of offences, penalties and operation that have to be followed when dealing with any waste.

5 PUBLIC PARTICIPATION

5.1 Sources of Information

Public participation is a key component while conducting an EIA study for any development project as it ensures that the views, suggestions, opinions and objections of the neighbouring people to any proposed project are sort and incorporated within the project phases. To this end the proposed project shall be advertised on local dailies and government printer to enable wider public participation for a period of one month. However additional questionnaires were administered besides the initially administered ones around the project area and below are some of the issues raised:

5.2 Issues Raised by the respondents

5.2.1 Increased number of housing units

With the construction of the proposed project, a total of one hundred and ninety modern housing units shall be added into the national housing stock after construction activities are complete. Adequate housing is one of the major challenges experienced by most city residents resulting to development of several informal settlements that are seen within the city. With the development of the proposed development, the proponents shall contribute towards trying to solve the problem.

5.2.2 Damaging of access roads

At present most if not all access roads within the project area are is a sorry state and ion the course of implementing the proposed project the proponents shall require delivery of various raw materials normally done through heavy lorries. These in most cases shall destroy the access roads further making them impassable especially during rainy seasons. The proponents must therefore ensure the roads are improved to better standards than they currently are to ensure easy movement.

5.2.3 Employment opportunities

Most of the respondents indicated that within the proposed project site, several young people from the local area shall benefit positively through the jobs that shall be created once construction activities begin on site. The proponents shall require various

professionals but specifically masons and construction labourers who shall benefit directly from the project. The respondents however suggested that the proponents consider sourcing for labour force locally before seeking elsewhere.

5.2.4 Opening up the place to other investors

Within the proposed project area there are several plots that have not been developed yet and the respondents indicated that with construction of such a modern residential village, several other absentee landowners may consider developing their properties hence improving the value of the project area. With the ever increasing value for land in the area, the land owners may also opt to sell their land to other serious investors who are more than willing to put up ventures in the area creating employment opportunities and business ventures hence improved living standards of the people in the area.

5.2.5 Increased Market/business opportunities

Throughout the construction period, the proposed project shall provide a sustained market for the supply of various building materials by local businessmen and women from the area such as ballast, sand, building blocks, cement and steel metals among others. Most respondents were of the opinion that the proponents/contractor considers sourcing construction materials locally before sourcing them from other areas. This is to help improve local businesses first before promoting other areas.

5.2.6 Air pollution

Some respondents expressed concern over the possibility of generation of large amount of dust from the construction activities which shall negatively impact on the local environment. The proponents were requested to keep dust levels within the required limits and be mindful of the neighbourhood through sprinkling of water along the access road, construction of a hoarding and provision of dust nets to prevent the spread of duct to neighbouring homesteads.

5.2.7 Noise pollution

There was concern over the possibility high noise levels in the project site as a result of excavation and construction works. The sources of noise pollution will include transport

vehicles, construction machinery, construction workers and metal grinding and cutting equipment among other sources. The respondents suggested that all construction activities must be limited to between 8am and 5pm during weekdays and 8am and 3pm during Saturdays. Some suggested that no construction activities should be carried out on site on Sundays and during any public holidays. Plastering if any that may required on site especially during ground preparation stage must be communicated to the neighbours in advance.

5.2.8 Optimal use of land

The respondents felt that with the construction of the proposed estate, the idle ten acres of land among many parcels that are undeveloped can yield more returns than when it is left idle. Land as we know especially within the city and the surrounding areas is scarce and very expensive to maintain and instead of the owner paying land rates to the county without getting any returns.

5.2.9 Waste generation and disposal

Some of the respondents were concerned on the unsightly scenarios associated with construction sites where solid waste is usually scattered all over the project area e.g. empty cement bags, rejected metals, wrappings (plastic bags), glass among others affecting negatively the scenic beauty of various project areas. Suggestions were made to the proponents to manage all the waste resulting from the project in an environmentally accepted manner to ensure that no wastes spills over to the neighbourhood

The respondents were also concerned in the manner in which the proponents shall be disposing off excavated soils from the ground preparation stage considering the location and condition of the proposed site. They suggested that the proponents/contractor must consider disposing off the excavated soils in a more environmentally friendly way to avoid inconviencing other residents.

5.2.10 Increased population in the project area

As a result of the project taking place, there shall be automatic increase in the number of people visiting the project area especially during construction and operational phases. With the increase in the number of people in a particular area comes with different vices as well as increased pressure on the available infrastructural facilities. The respondents urged the proponents through contractor to ensure workers onsite uphold integrity and decent behaviour at all times within and without the site.

6 IDENTIFICATION OF THE PROPOSED PROJECT IMPACTS

This section identifies both negative and positive impacts associated with the project. These impacts are hereby identified at two distinct phases of the project i.e. – Pre-construction & Construction Phase and Operational Phase. Another project will be carried out during the project's decommissioning phase.

6.1 Positive Impacts

6.1.1 Employment Opportunities

Several employment opportunities shall be one of the long-term major impacts associated with the proposed project that will be realised during construction, operation, maintenance and decommissioning phases of the proposed development. Both direct and indirect forms of employment shall arise from the project initiation. Direct employment will be mainly through skilled and unskilled labourers whose workforce shall be needed to build the proposed project.

The project shall also create indirect employment opportunities for people such as business people supplying construction materials to the project site, drivers and quarry workers among others.

6.1.2 Provision of additional modern housing units

Once construction of the proposed project is complete, the proponents shall have added a total of one hundred and ninety housing units to the county/country's housing stock. All the proposed units shall be constructed using modern construction technology which shall allow construction of modern facilities.

6.1.3 Economic Gains

Through the use of locally available materials during the construction phase of the project including cement, building blocks, steel metals, concrete and ceramic tiles, timber, sand, ballast, electrical cables among others, the project will contribute towards growth of the economy by contributing to the gross domestic product. The consumption of these materials, fuel oil and others will attract taxes including VAT which will be payable to

the government hence increasing government revenue while the cost of these raw materials will be payable directly to the producers.

6.1.4 Provision of Market for Supply of Building Materials

The project will require supply of large quantities of building materials most of which will be sourced locally within the sub county and other surrounding areas within the sub county. The proposed project shall provide ready market for building material suppliers such as quarrying companies, hardware shops and individuals with such materials.

6.1.5 Informal business growth

During construction period the informal sector will benefit from the operations. This will involve *Jua Kali* operators selling their products to be used on site. Such a move shall promote *Jua Kali* entrepreneurs in the local areas. Food business will also emerge as most of the workers who will be working on the proposed project site will be buying food from the informal business owners who shall be operating in the vicinity.

6.1.6 Optimal Land use

Land is a scarce resource in Kenya and through construction of the proposed project will ensure optimal use of land to the great benefit of the country and its people. Development of the under-utilized land for housing that complements economic activities hence improving the economy. The proposed project shall fully utilize the idle land and positively gain from the land.

6.2 Negative Impacts

6.2.1 Disposal of excavated soil and other debris

The proposed project site is located in an area dominant with black cotton soil which in normal occasion does not form stable foundations for buildings. For this reason, the proponents shall conduct extensive excavations on site to prepare for the proposed buildings. The proponents must ensure proper disposal of all the excavated soils and construction and demolition debris in order to prevent any possible environmental

degradation through poor disposal methods. It is encouraged that other alternative uses of this soil and debris should be found

6.2.2 Noise pollution

Most machines to be used in the construction sites are usually very noisy. It is for this reason that it is postulated that the construction works will generate some substantial amount of noise. The mixers, tippers, employees at the construction site, incoming vehicles to deliver construction materials, workers to site and other normal construction activities. This may prove to be a potential source of disturbance to the surrounding neighbours and a health hazard to the workers themselves. Such noise emissions should be minimised as much as possible from the source point while workers should be provided with appropriate personal protective wear.

6.2.3 Destruction of roads

The proponents must consider recarpeting the access road especially at Shangilia Baba na Mama houses that is completely worn out. This shall not only ensure easy passage for their trucks delivering raw materials but also benefit the residents. Currently the access roads are in a sorry state and the several trucks moving materials into the site may worsen the situation if not properly taken care of.

6.2.4 Air pollution

All construction activities are potential sources of air pollution through the release of dust to the environment. A lot of dust is usually generated during construction and demolition activities and therefore the proponents must ensure all the dust generated is suppressed through sprinkling of water on loose soils, constructing a hoarding around the project site, compacting loose areas and providing dust nets especially while doing the upper floors of the proposed project.

6.2.5 Generation of exhaust emissions

Exhaust emissions are likely to be generated during the construction period by the various construction machineries and equipments. Motor vehicles used to mobilise the

work force and materials for construction would cause a potentially significant air quality impact by emitting pollutants through gaseous exhaust emissions.

6.2.6 Solid waste generation

Large amounts of solid waste will be generated during construction of the project. These will include metal cuttings, rejected materials, surplus materials, surplus spoil, excavated materials, paper bags, empty cartons, empty paint and solvent containers, broken glass among others. Solid wastes if not well-managed have a potential of causing disease outbreaks due to suitable breeding conditions for vectors of cholera and typhoid. Malaria outbreak could also be exacerbated by the presence of open water ditches for breeding of mosquitoes. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment, invasion of scavengers and informal recycling communities.

6.2.7 Waste water generation

Within the proposed site there shall be approximately a total of one hundred and fifty construction employees during the construction phase who shall be generating large amounts of waste water while on site. Failure to provide adequate waste water management facilities shall lead to environmental pollution and even break up of various water borne diseases within the project area. The contractor/proponents must ensure adequate means of waste water management facilities are provided on site across all phases of the proposed site.

6.2.8 Accidents and hazards

During construction of the proposed project, it is expected that construction workers are likely to have accidental injuries and hazards. All necessary health and safety guidelines should be adhered to so as to avoid such circumstances.

Workers are also likely to be exposed to diseases from contact with potentially harmful building materials. It is therefore recommended that before the construction commences,

there is need for the materials to be well inspected and ensured to be harmonised to the occupational health and safety standards.

6.2.9 Emergence of social misdemeanour

There may be cases of social misdemeanour in the neighbourhood such as people playing loud music at night; domestic fights, drug abuse/alcohol abuse and many more thereby causing disturbances within the neighbourhood.

6.2.10 Cultural conflicts

Cultural conflicts may occur as a result of various communities with different cultures living in the proposed housing project once complete. For instance, in other communities their culture allows them to visit each other freely while other cultures prohibit visitation.

7 . MITIGATION MEASURES AND MONITORING PROGRAMMES

Introduction

This chapter highlights the necessary mitigation measures for the expected negative impacts of the proposed project. The potential impacts and the possible mitigation measures have herein been analyzed. References are also made as to where decommissioning mitigation measures can be sought.

7.1 Air pollution

Controlling dust generation from the proposed site during construction and demolition is useful in minimizing health (respiratory and eye) complications. It is recommended that a standard set of feasible dust control measures be implemented throughout the phases. Emissions of other contaminants (Nitrogen oxides, Carbon dioxide, Sulphur oxides, and diesel related Particulate Matter) that would occur in the exhaust from heavy equipment are also included.

The proponents are committed to implementing measures that shall reduce air quality impacts associated with the dust. All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Each driver to the proposed site or those operating the heavy machines on site will be under strict instructions to minimize the amount of dust generated while at the site.

The following additional measures shall be put in place to control the amount of dust generated and spread to neighbouring residential homes:

(i) Watering all active construction and demolition areas at least twice daily.

(ii) Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard.

(iii) Construction of a hoarding fence around the construction site to prevent the spread of dust.

(iv) Provide a dust net on individual houses especially while constructing and demolishing the upper floors

(v) Avoid construction and demolition activities in extreme dry and windy weather to limit the amount of dust being carried away.

(vi) Properly planning delivery of construction materials to the site and collection of debris from site for disposal.

7.2 Noise pollution

Significance of noise impacts depends on whether the project would increase noise levels above the existing ambient levels by introducing new sources of noise. Noise impacts would be considered significant if the project would result in the following:

(i) Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.

(ii) Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels.

(iii) A substantial permanent increase in ambient noise levels (more than five dBA) in the project vicinity above levels existing without the project.

(iv) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

The proponents shall put in place measures that shall mitigate noise pollution arising from the proposed site especially during construction and demolition phases. The following noise-suppression techniques shall be employed to minimise the impact of the noise generated at the project site.

(i) Limit construction activities to between 8am to 5pm to ensure minimum disturbance to the neighbours.

(ii) No construction activities shall be carried out on site on Sundays and public holidays since most if not all residents are within their homes.

(iii) Ensure that delivery of all construction materials to the site is done on a week day between 10am and 2pm when most residents are out at their places of work.

(iv) Limit pickup trucks and other small equipment to an idling time of five minutes, observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.

(v) Properly sensitize employees on site to reduce the amount of noise that they generate while within the project site

(vi) Ensure all the employees on site are properly engaged throughout the day to avoid giving them idle time when they are likely to generate a lot of noise.

(vii) No blasting of stones without informing the neighbours in advance before the blasting is done.

7.3 Proper solid waste management

Considerable amounts of solid waste shall be generated across all phases (construction, operation and decommissioning) of the proposed project. The following are some of the recommended measures that may be employed to ensure proper solid waste management on site:

(i) Properly plan on the amount of construction materials needed on site to reduce the amount of wastage.

(ii) Provide proper storage for the procured materials to protect them from being spoilt.

(iii) If possible order materials in quotas as at when and the specific amounts required on site to avoid breakage

(iv) Use of durable, long- lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time.

(v) Use recycled materials if necessary.

(vi) Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste.

(vii) Use of construction materials containing recycled content when possible and in accordance with accepted standards.

(viii) Regularly collect all the solid waste generated on site during construction and decommissioning phases and ensure it is well disposed of

(ix) Donate all raw materials left after all construction activities are over and any other that can be salvaged during the decommissioning phase or reuse them elsewhere in similar projects.

(x) Ensure that all the solid waste collected from the operational phase is properly collected and disposed of at designated disposal sites by a licensed solid waste company preferably twice a week

7.4 Generation of exhaust emissions

In order to control exhaust emissions the following measures shall be implemented during construction.

(i) All vehicles into the site must be well serviced and maintained

(ii) Vehicle idling time shall be minimized

(iii) If possible use human labour as opposed to machineries

(iv) Equipments shall be properly and regularly serviced and maintained.

(v) Proper planning of transportation of materials and debris through ensuring vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road.

(vi) Use vehicles bringing in raw materials to ferry away debris for disposal during construction phase

7.5 Efficient water use

Large amounts of water shall be required across all the phases of the proposed project especially during construction and operational phases. Currently it is the responsibility of the Machakos County government to supply water to the project area and neighbouring sub counties. To ensure sustainable supply of water to the project site and later houses, the proponents need to explore other sources of water supply. The following are some of the available sources of water supply that can be considered by the proponents:

(i) Harvesting and storing rain water.

(ii) Provide water storage tanks big enough to store enough water to be used during rationing periods.

(iii) Sourcing water from local water suppliers/vendors who normally do it in lorries especially during the project construction phase.

(iv) Provide means of recycling all the waste water generated and reusing it within the village especially in irrigating the landscaped lawns.

(v) Drill a borehole on site to ensure adequate supply throughout the project phases.

7.6 Occupational Health and Safety of employees

Worker accidents are normally inevitable on a construction/demolition site especially when human labour is utilised as opposed to machineries. The proponents must therefore ensure the following mitigation measures are put in place to ensure the safety of employees while on site is properly taken care of:

(i) Regular occupational health and safety training and always ensure there is an occupational health and safety employee within the site at all times while any works are going on

(ii) Ensure that all employees are trained on basic first aid procedures on a regular basis

(iii) Provide well stocked first aid boxes across the project site

(iv) Ensure current emergency numbers are well displayed across the project site

(v) Provide a standby ambulance on site just in case there is a severe accident

(vi) Ensure that adequate safety attires are provided to the employees and always ensure every employee puts them on

(vii) Provide adequate warning signs across the project site in areas where they can be seen easily

(viii) Restrict movement into and out of the project site while construction and demolition activities are ongoing. Only authorized personnel should be allowed into the project site

(ix) Avoid overpopulating the site especially during construction and demolition phases

(x) Ensure all construction equipments used in site is serviced in a regular basis and properly maintained

(xi) Ensure all those operating such machineries are properly trained and retrained through refresher courses to ensure that they master their skills properly

(xii) Ensure all employees on site undergo regular medical checkups to determine their suitability to deliver service on site.

(xiii) The site foreman must ensure that all staff members adhere to the set safety standards to ensure a safe working environment.

(xiv) Provide each employee with a medical insurance cover in case if any eventuality

7.7 Proper Management of waste water

Considering that the proposed project site is located in an area that does not have an operational sewer system, the proponents/contractor must provide adequate means of managing all the waste water generated from the project across all its phases to avoid any possibility of environmental pollution through discharge of the waste water into the environment.

During construction phase, the proponents/contractor shall provide adequate number of portable toilets that are easily maintained and cleaned. The company providing such facilities shall be responsible for its regular cleaning and disposal of the waste water there in.

The proponents shall then provide a reliable waste water treatment plant within the proposed housing project sourced from BioBox Limited. This system as explained in chapter two above, allows for recycling of the waste water to reusable standards before reusing the same recycled and treated water to irrigate the landscaped gardens established at all common areas within the project site and cleaning of common areas. The proponents must also apply for a discharge license from NEMA to allow them discharge any extra recycled water from the plant.

7.8 Proper disposal of excavated soil and demolition debris

For a stable foundation for the proposed project to be achieved the proponents shall be carrying out extensive excavation works on site to remove the black cotton soil currently within the project area. The proponents must therefore ensure that this soil is properly managed and disposed off in an environmentally friendly manner preferably used to reclaim the exhausted quarries within the project area. The same must be done for any construction and demolition debris to ensure a safe environment for the locals.

7.9 Cultural conflicts

The proponents and other residents must always strive to ensure no such conflict arises through conducting various social events amongst them that shall enhance cohesion among them. Whoever among them who might want to bring social and cultural

disharmony must be reported to the relevant authorities locally such as the area chief and police for action to taken against them

7.10 Construction of access roads

The access roads at the project area are currently poorly done and access by area residents is very difficult especially during rainy periods. The proponents must first repair the access road especially at Shangilia Baba na Mama housing section to ensure that all trucks moving into the proposed site move smoothly. In future maybe after construction activities are complete the proponents should consider tarmacking or cabro paving the access road all together. This shall not only be benefits the Lancet village residents but the residents neighbouring the village.

8. ANALYSIS OF PROJECT ALTERNATIVES

This section analyses the project alternatives in terms of site, technology scale and waste management options.

8.1 Analysis of alternative project site options

8.1.1 Relocation Option

Relocation option to a different site is an option available for the proposed project. At present the proponents do not have an alternative site and therefore it means for this option to be applicable to this project, they must search for an alternative site. Looking for the land of the same size to accommodate the proposed project targeting the same clientele and completing official transaction on it may take up to one or two years although there is no guarantee that land would be available. The proponents will spend another six months to one year on design and approvals/licensing since design and planning has to be according to site conditions. Project design and planning before the stage of implementation will cost the proponents additional millions of shillings besides what they have already spent.

Assuming the project will be given a positive response by all the relevant authorities at the new alternative site, this project would have been delayed for about two or three years before implementation. This is a delay that both the proponents and the Kenya economy can't afford. This would also lead to a situation like No Project Alternative option. The other consequence of this is that it would be a discouragement for private/local investors especially in the housing sector that has been shunned by many public and private investors.

In consideration of the above concerns and assessment of the current proposed site, relocation of the project is not a viable option.

8.1.2 Nil- intervention or No Project Alternative

The No Project option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental

perspective as it means non-interference with the existing environmental conditions. This option will however, involve losses both to the proponents and the country as a whole. The proponents shall continue to pay land rates for the site while the property remains idle. The No Project Option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- No additional housing to the already strained housing sector
- The local skills would remain under utilized.
- No employment opportunities shall be created for several Kenyans who shall have worked at the project site.
- Discouragement for investors to produce this level of affordable housing.

From the analysis above, it becomes apparent that the No Project alternative is no alternative to the local people, Kenyans, and the government of Kenya.

8.2 Analysis of Alternative Construction Materials and Technology

The proposed development shall be constructed using modern, locally and internationally acceptable materials to achieve public health, safety, security and environmental aesthetic requirements. Equipments that save energy and water will be given first priority without compromising on cost or availability factors. The concrete pillars and 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. Beautiful and durable reinforced concrete roofs with tiles finishing will be used because they are good in heat insulation as compared to the iron sheet roofs, and afford more security. This will ensure that the rainwater harvested will be used in the house and garden. Heavy use of timber during construction is discouraged because of destruction of forests. The exotic species would be preferred to indigenous species in the construction where need will arise. However, this housing methods and technologies to be used will require very little timber.

8.3 Domestic waste water management alternatives

Five locally available technologies are discussed below:-

8.3.1 Alternative one: *Waste Water Treatment Plant* (*Enpura UG & Pro System)*

This involves the construction of a plant that will enable the recycling of the waste water (black and grey) generated from the project activities to reusable standards and utilised within the site in activities such as irrigating the landscaped gardens and flashing of the toilets. It is usually expensive to construct compared to other technologies such as septic tanks, but it is the most reliable, efficient and cost-effective in the long term. This is the most preferred option for such project because of its benefits.

8.3.2 Alternative two: *Use of stabilization ponds/lagoons*

This refers to the use of a series of ponds/lagoons which allow several biological processes to take place, before the water is released back to the river. The lagoons can be used for aquaculture purposes and irrigation. However, they occupy a lot of space but are less costly. No chemicals are used/heavy metals sink and decomposition processes take place. They are usually a nuisance to the public because of smell from the lagoons/ponds. This option is not preferable in the area because the required space is not only available, and the surrounding community are not likely to accept the option.

8.3.3 Alternative Three: *Use of Constructed/Artificial wetland*

This is one of the powerful tools/methods used in raising the quality of life and health standards of local communities in developing countries. Constructed wetland plants act as filters for toxins. The advantages of the system are the simple technology, low capital and maintenance costs required. However, they require space and a longer time to function. Long term studies on plant species on the site will also be required to avoid weed biological behavioural problems. Hence it is not the best alternative for this kind of project.

8.4.4 Alternative Four: *Use of septic tanks*

This involves the construction of underground concrete-made tanks to store the sludge with soak pits. It is expensive to construct and regular empting in large discharge points.

In conclusion, the recommended course of action for this site would be a reliable waste water management system (Enpura UG & Pro System) as proposed above in chapter 2. This is the most preferred means of managing all the waste water owing to the fact that the proposed project area does not have an operational sewer line which would have been the most preferred.

8.5 Solid waste management alternatives

The proposed development will generate a lot of solid waste across all its phases and proper measures must be put in place for its proper management. An integrated solid waste management system is recommendable which is as follows.

a) First the proponents shall give priority to reduction at source of the materials. This option will demand a solid waste management awareness programme in the management and the residents.
b) The proponents should also consider Recycling, Reusing and composting of the waste as a second alternative in priority. This shall call for at source separation programme to be put in place. The recyclables may be sold to waste buyers locally or directly to any company that recycles waste such as plastic bags.
c) The third priority in the hierarchy of options is combustion of the waste that is not recyclable in order to produce energy.
d) Finally, sanitary land filling will be the last option for the proponent to consider.

9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 Significance of an EMP

Environmental Management Plan (EMP) for developing projects is usually to provide a logical framework within which identified negative environmental impacts can be mitigated and monitored. In addition the EMP assigns responsibilities of actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done. The EMP is a vital output of an Environmental Impact Assessment project as it provides a checklist for project monitoring and evaluation. The EMP outlined below will address the identified potential negative impacts and mitigation measures of the housing project based on the chapters of environmental impacts and mitigation measures of the negative impacts.

9.2 Construction Phase EMP

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the construction phase the housing project are outlined below.

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
Increased exploitation of natural resources for construction raw materials	▪ Source building materials from suppliers who practice environmental friendly processes in their operations.	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure accurate planning and estimation of actual amount of construction materials required to ensure that only the required materials are ordered	Proponents & Contractor	Throughout the construction period	200,000
	▪ Ensure that damage or loss of materials at the construction site are reduced to minimal levels through proper storage	Proponents & Contractor	Throughout the construction period	500,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Use at least 5%-10% recycled/refurbished or salvaged materials to reduce the use of natural raw materials	Proponents & Contractor	Throughout the construction period	-
Ecosystem disturbance	▪ Ensure proper demarcation and marking out of the project area to be affected by construction works and limit excavation works to such areas only.	Proponents & Contractor	1 month	50,000
	▪ Specify locations for trailers and machineries/equipments and areas of the site which should be kept free of traffic, equipment and storage.	Proponents & Contractor	1 month	50,000
	▪ Designate access routes and parking within the site.	Proponents & Contractor	1 month	100,000
Storm water runoff	▪ To avoid flooding within the project area during rainy seasons, create storm water management systems within the site and outside the project site to ensure efficient drainage system away from the project site owing to the fact that the proposed project is fairly flat	Proponents & Contractor	Throughout the construction period	3M
	▪ Allow for infiltration of storm water into the soil to avoid flooding by avoiding compacting/tarmacking the project area instead introduce cabro paved driveways and walk paths.	Proponents & Contractor	Throughout the construction period	500,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Ensure that construction vehicles are restricted to existing graded roads to avoid soil compaction within the project site.	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure that any compacted areas are ripped to reduce run-off.	Proponents & Contractor	6 months	200,000
Solid waste generation	▪ Through accurate estimation of quantities and sizes of construction materials required: order materials in the sizes and quantities they will be needed, rather than cutting them to size, or having large quantities of residual materials.	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure that construction materials leftovers are re-used elsewhere in other projects rather than being disposed of.	Proponents & Contractor	At the end of construction period	-
	▪ Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects	Proponents & Contractor	Throughout the construction period	50,000
	▪ Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or home owners.	Proponents & Contractor	Throughout the construction period	-
	▪ Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time	Proponents & Contractor	Throughout the construction period	_

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements	Proponents & Contractor	Throughout the construction period	2M
	▪ Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste by sourcing such materials such as cement directly from the factories who may deliver using trucks.	Proponents & Contractor	Throughout the construction period	-
	▪ Use construction materials containing recycled content where possible and in accordance with accepted standards.	Proponents & Contractor	Throughout the construction period	-
	▪ Reuse packaging materials such as cartons, cement bags, leftover steel metals and plastic containers to reduce waste at the site	Proponents & Contractor	Throughout the construction period	-
	▪ Provide adequate solid waste collection facilities across the construction site and ensure they area regularly emptied.	Proponents & Contractor	Throughout the construction period	100,000
	▪ Dispose waste more responsibly by dumping at designated dumping sites or landfills only through the use of a registered waste disposal company is encouraged	Proponents & Contractor	Throughout the construction period	500,000
Air pollution	▪ Ensure strict enforcement of on-site speed limit regulations	Proponents & Contractor	Throughout the construction period	200,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Avoid excavation works in extremely dry weather	Proponents & Contractor	Throughout the construction period	-
	▪ Sprinkle water on graded access routes each day to reduce dust generation by construction vehicles	Proponents & Contractor	Throughout the construction period	50,000/ month
	▪ The proponents should also consider recarpeting the access road to the construction site to reduce the amount of dust generated within the project area during this phase of the project when several heavy vehicles shall be moving into the proposed site.	Proponents & Contractor	Throughout the construction period	5M
	▪ Construct a hoarding fence around the proposed project site before any construction activities commence on site	Proponents & Contractor	Throughout the construction period	2M
	▪ Provide a dust net on the upper floors of the proposed buildings to prevent the spread of dust to neighbouring residential houses and must be retained until all construction activities are done	Proponents & Contractor	Throughout the construction period	1M
	▪ Sensitise truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, and switching off vehicle engines at these points	Proponents & Contractor	Throughout the construction period	-

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Ensure all trucks to the construction site especially those delivering construction materials are properly covered to prevent the spread of dust.	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure proper planning of transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done per vehicle or the number of vehicles on the road	Proponents & Contractor	Throughout the construction period	1,000
Noise Pollution	▪ Sensitise construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Proponents & Contractor	Throughout the construction period	1,000
	▪ Sensitise construction drivers to avoid gunning of vehicle engines or hooting while within the proposed project area	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure that construction machinery are kept in good condition through regular servicing and maintenance to reduce the amount of noise generated	Proponents & Contractor	Throughout the construction period	100,000
	▪ All construction activities must be restricted to between 8am and 5pm during weekdays and 8am to 3pm on Saturdays. No construction activities must be done on Sundays and public holidays	Proponents & Contractor	Throughout the construction period	-
	▪ No construction activities shall be carried out on site at night	Proponents & Contractor	Throughout the construction period	-

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ No blasting of stones if any shall be carried out within the project without prior notice being issued to local residents	Proponents & Contractor	Throughout the construction period	-
	▪ The proponents should also consider using human labour as opposed to machineries to reduce the noise levels within the site	Proponents & Contractor	Throughout the construction period	-
	▪ The proponents should also consider using trucks that bring in raw materials to the project site to ferry away any construction debris for disposal in order to reduce the number of vehicles to the site	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure that all generators and heavy duty equipment are insulated or placed in enclosures to minimize ambient noise levels.	Proponents & Contractor	Throughout the construction period	500,000
Exploitation and pollution of water resources	▪ Seek other sustainable sources of water supply to the construction site such as supply from vendors	Proponents & Contractor	Throughout the construction period	-
	▪ The proponents must ensure that all necessary licenses are sought before sinking of a borehole as proposed	Proponents & Contractor	One-off	-
	▪ Promote recycling of all waste water generate within the project site and reuse the recycled water within the project site	Proponents & Contractor	Throughout the construction period	-
	▪ Promptly detect and repair of water pipe and tank leaks to avoid any form of wastage	Proponents & Contractor	Throughout the construction period	Cost to be determined by the technician

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Ensure taps are not running when not in use	Proponents & Contractor	Throughout the construction period	-
Waste water management	▪ Provide adequate facilities (mobile toilets) for handling all the waste water generated by construction workers	Proponents & Contractor	Throughout the construction period	100,000/ month
	▪ Ensure that such facilities are adequate for all the employees on site across this phase and are cleaned on a daily basis	Proponents & Contractor	Throughout the construction period	100,000/ month
	▪ Ensure that no waste water is discharged into the immediate environment	Proponents & Contractor	Throughout the construction period	-
	▪ Monitor effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated	Proponents & Contractor	Throughout the construction period	20,000/ month
Violation of rules and regulations/ Mishaps	▪ Ensure that all building plans are approved from all departments of the County Government responsible with such matters such as planning and engineering among others	Proponents	One-off	3-5M
	▪ Registration of the premises under the Factories and Other Places of Work Act Cap 514, Laws of Kenya is mandatory	Proponents	One-off	5,000
	▪ A general register should be kept within the facility as stipulated in Sec 62 (1) of the Factories and Other Places of Work Act.	Proponents & Contractor	One-off	5,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ The abstract of the Factories and Other Places of Work Act must be displayed at prominent places within the site	Proponents & Contractor	One-off	5,000
	▪ Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place.	Proponents & Contractor	Throughout the construction period	10000/ month
	▪ Ensure that the premises and all the employees are insured as per statutory requirements (third party and workman's compensation)	Proponents	Throughout the construction period	1M
	▪ Develop, document and display prominently an appropriate Safety and Health policy for construction works	Proponents & Contractor	Throughout the construction period	50,000
Storage of materials	▪ Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse	Proponents & Contractor	Continuous	100,000
	▪ Ensure procurement of construction materials is done to those materials that are required only at a particular time	Proponents & Contractor	Continuous	500,000
	▪ Ensure that items are not stored/stacked against weak walls and partitions	Proponents & Contractor	Continuous	_
Occupational health and safety	▪ Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency	Proponents & Contractor	One-off	250,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Such procedures must be tested at regular intervals	Proponents & Contractor	Every 3 months	100,000
	▪ Ensure that adequate provisions are in place to immediately stop any operations where there in an imminent and serious danger to health and safety and to evacuate workers.	Proponents & Contractor	One-off	500,000
	▪ Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site	Proponents & Contractor	One-off	50,000
	▪ Provide measures to deal with emergencies and accidents including adequate first aid arrangements	Proponents & Contractor	Throughout the construction period	20,000
	▪ Ensure that a well trained nurse and an occupational health and safety officer are hired and stationed within the project site to ensure that all the occupational health and safety measures are implemented and first aid administered to the employees	Proponents & Contractor	Throughout the construction period	100,000 per month
	▪ Well stocked first aid box which is easily available and accessible should be provided within the premises	Proponents & Contractor	One-off	20,000
	▪ Provision must be made for persons to be trained in first aid, with a certificate issued by a recognised body.	Proponents & Contractor	One-off	10,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Fire fighting equipment such as fire extinguishers and hydrant systems should be provided at strategic locations such as stores and construction areas.	Proponents & Contractor	One-off	500,000
	▪ Regular inspection and servicing of the equipments must be undertaken by a reputable service provider and records of such inspections maintained	Proponents & Contractor	Every 3 months	5,000
	▪ Adequate warning and instruction signs must be prominently displayed within the project site	Proponents & Contractor	One-off	10,000
	▪ Electrical fittings near all potential sources of ignition should be flame proof	Proponents & Contractor	One-off	–
	▪ Ensure that workers at the construction site and other dusty sites are adequately protected from inhalation of substantial quantities of dust through provision of suitable protective gear (e.g. nose masks)	Proponents & Contractor	One-off	200,000
	▪ Provide workers in areas with elevated noise and vibration levels, with suitable ear protection equipment such as ear muffs	Proponents & Contractor	One-off	200,000
	▪ Provide suitable and adequate personal protection equipments such as overalls, safety footwear, dust masks, gas masks, respirators, gloves, ear protection equipment and helmets among others to everyone within the site and ensure they are worn at all times.	Proponents & Contractor	Once off	500,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
	▪ Ensure that every visitor to the construction site is briefed on the basic safety standards and provided with basic safety attires before accessing the construction site	Proponents & Contractor	Throughout the construction period	-
	▪ Limit public access to the construction site and ensure any one visiting the site registers his/her name before accessing the site	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure that all construction machineries are operated by experienced personnel in order to avoid any accidents while on site	Proponents & Contractor	Throughout the construction period	-
	▪ Ensure that all employees operating machineries undergo regular refresher training courses to sharpen and refresh their skills	Proponents & Contractor	Throughout the construction period	50,000 per training
	▪ Regularly service all the machineries on site and ensure all worn out parts are replaced promptly	Proponents & Contractor	Throughout the construction period	500,000/ month
	▪ Ensure that all construction employees undergoes regular medical checkups to determine suitability to continue working within the construction site	Proponents & Contractor	Throughout the construction period	50,000 per check
	▪ Ensure that construction workers are provided with an adequate supply of wholesome drinking water which should be maintained at suitable and accessible points.	Proponents & Contractor	One-off	20,000/ month

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Kshs)
Sanitation	▪ Ensure that conveniently accessible, clean, orderly, adequate and suitable washing facilities are provided and maintained in within the site	Proponents & Contractor	One-off	300,000
	▪ Provide and maintain adequate and suitable storage for clothing not worn during working hours for construction employees	Proponents & Contractor	One-off	20,000
	▪ Provide and maintain, for the use of all workers whose work is done standing, suitable facilities for sitting sufficient to enable them to take advantage of any opportunity for resting which may occur in the course of their employment	Proponents & Contractor	One-off	50,000
	▪ All work places must be kept in a clean state, and free from effluvia arising from any drain, sanitary convenience or nuisance	Proponents & Contractor	Continuous	20,000/ month
	▪ Accumulations of dirt and refuse should be cleaned daily basis	Proponents & Contractor	Daily	20,000/ month
	▪ Provision for repairing and maintaining of hand tools must be in place	Proponents & Contractor	One-off	50,000

9.3 Operational Phase EMP

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the operational phase of the homes are outlined in the table below:

Objective/Plan	Recommended Mitigation Measures	Responsible Party	Timeframe	Cost (Kshs)
Solid waste generation	▪ Provide solid waste handling facilities such as waste bins across the village and ensure that they are often emptied to enhance maximum cleanliness.	Proponents	One-off	200,000
	▪ Ensure that solid waste generated at the village is regularly collected for disposal at authorised dumping sites	Proponents	Continuous	100,000/ month
	▪ Introduce a solid waste management fees to all the residents begged on the amount of solid waste they generate from their individual houses	Proponents	Continuous	100 per kilogram me of solid waste
	▪ Encourage separation of solid waste at source to pick recyclable waste for recycling	Proponents/ residents	Continuous	-
	▪ Sensitize residents on the importance of proper solid waste management practices and encourage the best practices such as separation at source, recycling, reuse and proper disposal procedures.	Proponents	Continuous	0
	▪ Introduce awards for people practicing best practices in solid waste management	Proponents	Quarterly	30,000

Objective/Plan	Recommended Mitigation Measures	Responsible Party	Timeframe	Cost (Kshs)
	▪ Contract a private service provider licensed by NEMA and the county government to help dispose all the solid waste generated from the village at designated disposal sites within the county	Proponents	Continuous	50,000 per month
	▪ Donate redundant but serviceable equipments to charities and institutions	Proponents	Continuous	0
Waste water management	▪ Considering that the project area does not have a functional sewer system, the proponents must provide an adequate, efficient and safe means of handling sewage generated at the project. Based on the number of people expected to reside within the project site once complete, the system need to allow for recycling of the generated waste water	Proponents & Contractor	One-off	3M
	▪ Ensure all the recycled water meet the required standards before being reused or released into the environment	Proponents	Continuous	
	▪ The proponents must also apply for a waste water discharge licence from NEMA once the system is up and running.	Proponents	One off	10,000
	▪ Conduct regular inspections for waste water piping system for any blockages or damages and fix appropriately	Proponents & Contractor	Continuous	10,000 per inspection
	▪ Ensure regular monitoring of the sewage discharged from the project to ensure that the stipulated sewage/effluent discharge rules and standards are not violated	Proponents	Continuous	5,000/ parameter

Objective/Plan	Recommended Mitigation Measures	Responsible Party	Timeframe	Cost (Kshs)
Energy consumption	▪ Switch off electrical equipment, appliances and lights when not being used	Proponents	Continuous	0
	▪ Install occupation sensing lighting at various locations such as commercial centre, drive ways, foot paths and all the common areas of the project.	Proponents	One-off	0.5M
	▪ Encourage the use of energy saving bulbs within all the houses as opposed to the normal bulbs.	Proponents	Continuous	-
	▪ Monitor energy use during the operation of the project and set targets for efficient energy use	Proponents	Continuous	2,000/ month
	▪ Provide solar power system at all houses especially for warming of water to the showers to reduce the amount of electric energy that shall be used to warm water	Proponents	One off	3M
Water use	▪ Promptly detect and repair of water pipe and tank leaks	Proponents	Continuous	100,000/ month
	▪ Residents to conserve water e.g. by avoiding unnecessary toilet flushing.	Proponents	Continuous	-
	▪ Ensure taps are not running when not in use	Proponents	Continuous	-
	▪ Install water conserving taps that turn-off automatically when water is not being used	Proponents	One-off	1M
	▪ Install discharge meters for every house to determine and monitor usage	Proponents	One-off	100,000

Objective/Plan	Recommended Mitigation Measures	Responsible Party	Timeframe	Cost (Kshs)
Health and safety risks	▪ Implement all necessary measures to ensure health and safety of workers and the general public during operation of the apartments as stipulated in Factories and Other Places of Work Act Cap 514	Proponents	Continuous	20,000
safety and security of the premises and surrounding areas	▪ Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises during night hours.	Proponents	Continuous	100,000/ month

9.4 Decommissioning Phase

In addition to the mitigation measures provided in two above tables in this chapter, it is necessary to outline some basic mitigation measures that will be required to be undertaken once all operational activities of the proposed project have ceased. The necessary objectives, mitigation measures, allocation of responsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the project, are outlined in the table below:

Environmental impact	Recommended Mitigation Measures	Responsible Party	Time Frame	Estimated Cost (Kshs)
Solid waste generation	▪ All decommissioning debris that will not be recyclable must be disposed off properly away from the project area at designated disposal sites	Contractor, Proponents	One-off	500,000
	▪ The proponents should also ensure that materials that may be reused elsewhere in similar projects be reused instead of disposal.	Contractor, Proponents	One-off	-
	▪ Donate reusable decommissioning waste to charitable organizations, individuals and institutions	Contractor, Proponents	One-off	-
Air pollution	▪ Ensure that no demolition activities are undertaken during extremely dry and wind weather	Contractor, Proponents	One-off	-
	▪ Maintain the existing boundary wall until all demolition activities are done to act as a hoarding to prevent the spread of dust	Contractor, Proponents	Continuous	-
	▪ Sprinkle water on all loose debris within the site while demolition activities are on going	Contractor, Proponents	continuous	20,000

Environmental impact	Recommended Mitigation Measures	Responsible Party	Time Frame	Estimated Cost (Kshs)
Aesthetic quality of the site	▪ Consider re-vegetating the site after all demolition activities are complete and properly tender, manage and irrigate them until they are fully established	Contractor, Proponents	Throughout the decommissioning phase	200,000
	▪ Maintain the established landscaped gardens that were planted during operation phase	Contractor, Proponents	Throughout the decommissioning phase	-

10 CONCLUSION AND RECOMMENDATIONS

The proposed Lancet Village shall bring with it numerous positive impacts including creation of additional employment, quality shelter, improved businesses in the project area especially for various suppliers, increase in national housing stock and increase in revenue to both the county and national governments among others has outlined in the report.

The negative environmental impacts that will result from establishment of the project which include air pollution, noise pollution and generation wastes among others which however can be mitigated.

The proponents have committed to put in place various mitigation measures mitigate the negative environmental, safety, health and social impacts associated with the proposed development. It is recommended that in addition to this commitment, the proponents should focus on implementing the measures outlined in the EMP as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects.

It is also recommended that the positive impacts that emanate from such activities shall be maximised as much as possible. It is expected that these measures will go a long way in ensuring the best possible environmental compliance and performance standards.

REFERENCES

Republic of Kenya, (1968) **The Building Code.**

Republic of Kenya, (1999) **The Environmental Management and Coordination Act, No. 8 of 1999.**

Republic of Kenya, (2003) Legal Notice No. 101. **The Environmental (Impact Assessment and Audit) Regulations, 2003**

Republic of Kenya, (2012) **The County Government Act (Cap. 265)**

Republic of Kenya, (1972) **The Public Health Act, CAP 242**

Republic of Kenya, (1982) **The Factories and Other Places of Work Act, CAP 514**

Republic of Kenya, (1996) **The Physical Planning Act, CAP 286**

APPENDICES

- ✓ *Photographic representation from the project site*
- ✓ *Lead expert's practicing certificate*
- ✓ *Site location map*

PHOTOGRAPHIC REPRESENTATION FROM THE PROPOSED PROJECT SITE

Shangilia Baba na Mama Micro-Intervention programme Merry go round loan housing scheme neighboring the proposed project site

PEFA church under construction directly opposite the project site

Proposed project site and neighboring residential houses

Seventh day Adventist church, Katani West within the project area

Electricity supply to the project area

SITE LOCATION MAP

FORM 7 (r.15(2))

nema
mazingira yetu | afai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/4379

Application Reference No: NEMA/EIA/EL/6569

M/S **Walter Ongeto Omwenga**
(individual or firm) of address

P.O. BOX 17874-00500, Nairobi

is licensed to practice in the capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert**
registration number **2315**

in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **1/10/2017** Expiry Date: **12/31/2017**

Signature…..

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified