ENVIRONMENT IMPACT ASSESSMENT (EIA) STUDY REPORT

For

A Proposed Operation of a Small Brick Incinerator at Diani Beach Hospital

Plot no Kwale / Diani Complex / 1

Proponent: Dr. K. S. Rekhi

Compiled by
Alex Maina
EIA / EA Expert NO. 2045

April, 2021

CERTIFICATION

AFFIRMATION BY EXPERT

I, Mr. **Alex Maina** (EIA/EA Lead Expert, Registration No. 2045), affirm that to the best of my knowledge, the contents of Environmental Impact Assessment (EIA) study report are a correct representation of the findings of the assessment carried out for the incinerator at Diani Beach Hospital. This report has been done with reasonable skills, care and diligence in accordance with the *Environmental Management and Coordination Act, 1999 together with Environmental* Management and Co-ordination (Amendment) Act, 2015, 2019 amendment of the second schedule of EMCA 1999 and the Environmental Impact Assessment and Audit Regulations, 2003.

Lead Expert Signature
Date:...***20/04 / /2021***

AFFIRMATION BY PROPONENT

I , **Dr. K. S. Rekhi**, on behalf of ***Diani Beach Hospital*** proponent of the proposed operation of an Incinerator located at Diani Beach Hospital, Kwale County acknowledge that to the best of my knowledge, the contents of this study report is a correct representation of the findings of the Environmental Impact Assessment.

Signature

Date:... 20***/04/2021***

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ACRONYMS

1.	C	Centigrade
2.	Cap	Capitulus, "chapter"
3.	CO	Carbon Monoxide
4.	COVID	Coronavirus disease
5.	EIA	Environmental Impact Assessment
6.	EMCA	Environmental Management and Coordination Act
7.	EMP	Environmental Management Plan
8.	ha	Hectare
9.	HCl	Hydrogen chloride
10.	Hr	Hour
11.	ICT	Information and Communication Technologies
12.	Kg	Kilogram
13.	KP	Kenya Power
14.	m^3	Cubic meter
15.	min	Minute
16.	mm	Millimeter
17.	NEC	National Environmental Council
18.	NEMA	National Environmental Management Authority
19.	NO	Nitric oxide
20.	O	Oxygen
21.	OHS	Operation Health and Safety
22.	OSHA	Occupational Safety and Healthy Act
23.	PPEs	Personal Protective Equipments
24.	SDGs	Sustainable Development Goals
25.	SO	Sulfur oxide
26.	SOPs	Stardard Operating Procedures

EXECUTIVE SUMMARY

The purpose of this Environmental Impact Assessment study report to be submitted to the National Environmental Management Authority (NEMA) is to grant the Diani Beach Hospital an opportunity to start using the small brick incinerator placed within the hospital. The incinerator is expected to handle some general and medical wastes generated during operations of the hospital. Some of the of medical waste to be incinerated include textiles, plastics and packaging. It can also incinerate most types of drugs, medicines, vaccines and sharps – as long as they are mixed with other wastes..This comes from the understanding that general and medical Waste will be generated during the diagnosis, treatment and immunization of humans is capable of producing infectious diseases and includes sharps (e.g. used needles and blades), infectious, and pathological waste containing HIV and other blood-borne pathogens, as well as pharmaceutical wastes.

This report therefore presents a detailed EIA study for the establishment and operation of the said incinerator. This study was prepared upon a request from the proponent to fulfil the requirements Environmental Management and Co-ordination (EMCA) 1999 and the EMCA (Amendment) Act, 2015 and in particular part II of the Environmental (Impact Assessment and Audit) Regulations, 2003. EIA/ Audit Regulations emphasis that *Environmental Impact Assessment (EIA) is a critical examination of the effects of a project on the environment. Any proponent of a project should conduct an EIA and prepare a report and submit to NEMA. The EIA must be done by a registered and licensed EIA/EA expert by NEMA. The EIA must be conducted before the commencement of the project.* The study tackles in detail all the environmental aspects, elements, impacts and the mitigation, safeguards and risk elimination measures that should be followed/carried out in order to protect the workers, patients, clients and the environmental elements and keep them all safe and secure.

Incineration will be one of the methods of treatment of some hospital waste which will be done by high-temperature burning—prior to final disposal. However most of major wastes from the hospital will be incinerated from a private incinerator in a different location. It is hoped to reduce the volume of the waste and eliminate pathogens. It is more efficient than open-air burning, and is preferable because the incerator is of good quality and there is a well-trained operator. It is hoped to reduce the volume waste, to reduce the potential infectious properties and volume of medical waste, and to reduce the potential toxicity and volume of the waste in the hospital.

The project may have some potential risks to human health that might result from the emission of pollutants generated by the incineration process. However, such effects will generally be mitigated.

This EIA recommends that the incinerator be licensed provided the outlined mitigation measures are adhered to. Major concerns should nevertheless be focused towards minimizing the occurrence of impacts that would degrade the general environment. This will be achieved through close follow-up and implementation of the recommended Environmental Management plan (EMP).

1.0 BACKGROUND INFORMATION

1.1 Introduction

Hospitals are invariably associated with the generation of large quantities of waste very rich in pathogens. The handling, transport and disposal of such wastes is expensive and also has inherent risks to human health. Improper management of waste generated within the hospital can cause a direct health impact on the patients, workers and the community. Likewise, every day, in Diani Beach Hospital, some amount of potentially infectious bio-medical waste is generated. Indiscriminate disposal of this waste and exposure to such waste possess serious threat to environment and to human health and so bio-medical waste requires specific treatment and management prior to its final disposal. The hospital ensures that the waste is managed properly by ensuring proper segregation at the source, the use of accurate packaging (leak resistant, puncture resistant and not susceptible to degradation by cleaning agents in case the packaging is reused), appropriate colour coding, proper in-house movement of waste (minimizing employee exposure to the waste in a workplace), and designating waste storage areas near the incinerator.

Key steps followed while conducting the study were screening, scoping, data collection and compilation, environmental screening and impact assessment, documentation and consultation. Screening process comprised compilation and review of information on the project. Most of this information was obtained from the proponents and added to data on relevant legislation, Regulations, guidelines and standards. Documentation was the last step of the study, which comprised collation of data and preparation of this report along with requisite appendices in proof of the study and its findings.

The proponent is required to present this report in order to comply with the Environmental Management and Co-ordination (EMCA) 1999 and the EMCA (Amendment) Act, 2015 and in particular part II of the Environmental (Impact Assessment and Audit) Regulations, 2003. The report has provided a summary statement of the likely environmental effects of the proposed project.

1.2 EIA Expert

This EIA has been carried oiut by Alex Maina who is a seasoned NEMA registered Environmental Auditor / Environmental Impact Assessment expert with very long experience. He holds a Masters degree in Environmental Management from the University of Cape Town in South Africa and is a NEMA certified EIA Expert. His expertise is expansive and elaborate based on his previous involvement in conducting Environmental Assessments and Environmental Audits.

1.3 Project type

Diani Beach hospital proposes to start using a small incinerator at its facility. The operation of the proposed incinerator conforms to the 3rd schedule of the Environmental Management and Coordination (Waste Management) Regulations of 2006. It is considered as class ***Class 2B: Small Scale Incinerators for Private Use Incinerators for the disposal of hazardous, potential hazardous and bio-medical waste where the operator does not exceed 100 kg/ day.***

1.4 Benefits of the Incinerator

The incinerator has an overall positive implication to the hospital and the general environment. The major threat to the environment and human health today is risks associated with waste management. Not all waste sources are capable of handling hazardous and toxic materials within the premises without compromising the health of their own workers or the neighboring communities. The result of waste generators disposing wastes without appropriate equipment has been pollution of environmental resources and particularly water sources, air pollution, land contamination and even direct effects to human health. In this regard, therefore, the following are considered main benefits of this incinerator

- Cleaning up of hazardous and toxic materials from the hospital;
- Provision for disposal of expired drugs and medicines from hospitals, most of which do not have a professional mode of the waste disposal;
- Provision of a safe point for reducing the volumes of hazardous waste and toxic wastes before disposal into appropriate county's dumpsite,
- The facility will provide a multiple of direct and indirect employment opportunities within the hospital

1.5 Project Justification

Diani beach hospital continuously generates medical, biodegradable, non-biodegradable and recyclable solid waste from its various activities. Some of these wastes need professional attention for effective management as the infectious nature of the waste can cause irreparable damage to the human health and the environment. It has become imperative to monitor and control the management and handling of these wastes. Due to the proposed use of the incinerator, some of the bio medical waste will be properly treated and disposed. Various communicable diseases, which spread through water, sweat, blood, body fluids and contaminated organs, are important to be prevented. The bio medical waste spread in and around the hospitals calls flies, insects, rodents, cats and dogs that are responsible for the spread of communication disease like plague and rabies.

1.6 Purpose of this EIA

Environmental Impact Assessment (EIA) is one of the proven tools of facilitation to achieve the goal of environmentally and socially sound and sustainable development. The output of this work is an EIA study report for the purposes of applying for an EIA license and to propose workable mitigation measures. Whatever safeguards and measures to be carried out, the proposed project might have some negative impacts on the workers and environment that should be mitigated. So, as a result, this Environmental Impact Assessment study was prepared with the aim to provide a review, analysis and recommendations of the best mitigation measures that the proponent should consider during operation.

The importance of conducting an EIA for any project is to:

- Determine whether the proposed investment may result in environmental or social impacts;
- Identify these impacts; the negative as well as the positive;
- Propose the suitable mitigation and monitoring measures to protect the environment and give details for administering and monitoring the potential environmental impacts and their mitigation measures;
- Propose applicable safeguard documentation to address potential impacts;

- Evaluate the existing institutional capacity of the company staff to manage the recommendations for implementing the proposed measures
- Provide recommendations to build capacity and strengthen environmental management and awareness;
- Develop procedures to identify and address potential environmental and social safeguard issues.
- Formulate implementation framework for the proposed mitigation measures, responsible persons, required resources and implementation schedule.

1.7 Objectives of the report

The report of this assessment is very important because it seeks:

- To ensure compliance with the provisions of the EMCA 1999 (together with the revised 2015 EMCA Act, and the Environmental (Impact and Assessment/Audit) Regulations 2003 as well as other statutory requirements;
- To ensure that project activities are clearly understood with a view to isolate envisaged potential impacts; and,
- To ensure that the proposed project does not compromise the well-being of the Ukunda community.

1.8 Biomedical waste management

Biomedical and health-care waste require special attention. In order to properly manage bio medical waste, Biomedical wastes must be segregated first from “regular” wastes and then according to the following categories:

- Non-sharp infectious waste (such as laboratory cultures and objects contaminated by blood or body fluids);
- Pathological waste (such as human body parts, blood, and body fluids);
- Sharp infectious waste (such as needles, scalpels, and infusion equipment);
- Pharmaceutical waste (such as drugs, vaccines, and serums);
- Chemical waste (such as formaldehyde);
- Waste containing heavy metals (such as thermometers and blood pressure gauges);
- Radioactive waste (such as radionuclides);
- Genotoxic waste (such as cytotoxic products used in cancer therapies); and
- Health care wastewater (which is treated through physical or chemical means, biological purification, lagooning, or sand filtering).
- At the site where it is generated, biomedical waste is placed in specially-labelled containers for removal by biomedical waste transporters.

1.9 Biomedical treatment options

Biomedical waste is treated by any or a combination of the following methods:-

- Incineration;
- Steam, chemical, or microwave sterilization.

Any tools or equipment that come into contact with potentially infectious material and are not disposable or designed for single-use are sterilized in an autoclave. Disposing of these materials with regular household garbage puts waste collectors at risk for injury and infection, especially from sharps items. Programs should be in place for the disposal of household biomedical waste.

Source reduction of biomedical wastes is important. For example, to avoid generating pharmaceutical wastes in the form of expired medication, small amounts of the required products should be ordered in a centralized manner, and products should be used in the order of their expiration dates. Only products designed specifically for re-use are to be re-used after appropriate cleaning and sterilization.

For small-scale initiatives, minimal requirements typically call for the incineration, encapsulation of biomedical wastes, considering the context. Other more efficient and/or more sustainable methods of treatment and disposal of biomedical wastes exist (such as chemical disinfection, wet thermal treatment, and microwave irradiation). However, these tend to be more complex and more expensive. If on-site incineration is the preferred option of treatment, considering the context, it should take place preferably in a static-grate, single-chamber on-site incinerator.

As a secondary option, on-site incineration may take place in a drum or brick on-site incinerator. Appropriately controlled incineration is generally adequate for non-sharp infectious wastes, pathological wastes, and sharp infectious wastes. The residues from burning (or ashes, which should contain less than 3% of unburned matter) are then buried using safe on-site burial methods or disposal in an authorized duming site.

1.10 Content of proposed project report

The content shall include but not limited to the outline provided in the Environmental (Impact Assessment and Audit) Regulations, 2003. Such as:

- The proposed location of the project;
- A concise description of the National Environmental Legislative and Regulatory framework, baseline information, and any other relevant information related to the project;
- The technology and procedures to be used in the implementation;
- An EMP proposing measures for eliminating, minimizing or mitigating adverse impacts on the environment, including time frame and responsibility to implement the measures and monitoring means; and,
- Such other matters as the NEMA may require.

1.11 Methodology Outline

The general steps followed during the assessment were as follows

- Environmental Screening, in which the project was identified as among those requiring EIA under schedule two (2) of EMCA, 1999;
- Environmental scooping that provided the key environmental issues;
- Desk top studies;
- Physical inspection of the facility and surrounding areas;
- Reporting;

1.12 Scope, Objective and Criteria of the Environmental Impact Assessment (EIA)

1.12.1 Scope of the Report

The scope of the study is to carry out the Environmental Impact Assessment (EIA) study to identify, predict and evaluate potential environmental and socio-economic impacts which may result from the proposed common bio-Medical Waste and to develop suitable Environment Management Plan (EMP) to mitigate the undesirable effects. The Study is aimed at:

- Collection of data related to physical, ecological and socio-economic resources of the project area;
- Review the available data, drawings (if available) and report to ascertain their adequacy and need for collection of additional data;
- Identification and evaluation of salient environmental impacts;
- Identification of necessary mitigation measures to minimize the adverse impacts;
- Preparation of Environmental Management Plan (EMP);
- Establishing the existing environmental conditions, identifying potential environmental impacts and identifying areas of significant environmental concerns due to the proposed project;
- Prediction of impacts on environment, socio-economic conditions of the people due to the proposed project;
- Preparation of Environmental Management Plan (EMP).

1.12.2 Project Objectives

The proposed project is for applying for permit from NEMA to use a small brick incinerator at Diani Beach Hospital and will help in:

- Source Reduction and waste minimization;
- Proper handling the hospital waste
- Reduce the scale of processes so that less waste is generated;
- Minimize the volume of waste solutions.
- Reducing the amount of waste transferred to the external outside incinerator outside the hospital

Specific objectives include:

- To identify possible environmental impacts, both positive and negative;
- To assess the significance of the impacts;
- To assess the relative importance of the impacts of relative plan designs, and sites;
- To propose preventive mitigation and compensative measures for the significant negative impacts of the project on the environment.
- Generate baseline data for monitoring and evaluating how well the mitigation measures are being implemented during the project cycle;
- To present information on impact of alternatives;
- To present the results of the EIA that can guide informed decision making and safe operation of the incineration plant

1.13 Data Collection Procedures

First, the EIA expert undertook collection of data, which 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

Environmental Impact Assessment Report 15 specified in Part V (section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003. Then data collected underwent environmental screening and scoping to avoid unnecessary data.

The purpose of this report, environmental and social baseline data and conditions at/ around the project site has been undertaken. The data has been gathered from different sources of information including consultation with the project proponent, private visits, fields surveys, desktop studies, existing information sources, interviews with the people at the hospital has been conducted to collect their opinion regarding the project after findings it has been concluded that project will not have any adverse impact on the socio economic environment of the exiting community or environment.

1.14 EIA Organization and Structure

The EIA was carried out to full completion within a period of twenty five (25) days from the date of undertaking. The EIA Expert underatook the the day-to-day study nd any related institutional support matters.

1.15 Reporting and Documentation

The Environmental Impacts Assessment Study Report from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared and submitted for consideration and approval. The Consultant ensured constant briefing of the client during the exercise.

1.16 Responsibilities and Undertaking

The EIA expert undertook to meet all logistical costs relating to the assignment, including those of production of the report and any other relevant material. He arranged for own transport and travels during the exercise. On the site of the proposed project, the proponent provided a contact person(s) to provide information required by the expert. The proponent provided details of raw materials, project cost breakdown, proposed process outline and anticipated by-products, future development plans, operation permits and conditions, land-ownership documents and site history.

The output from the expert includes the following:

- An Environmental Impact Assessment report comprising of an executive summary, assessment approach, baseline conditions, anticipated impacts and proposed mitigation measures,
- An Environmental Management Plan outline, which also forms part of the report recommendations.

2.0 PROJECT DESCRIPTION, DESIGN AND CONSTRUCTION

2.1 Project Description

Diani beach hospital seeks to operate a small brick incinerator designed to be operated at temperatures of 800o C and higher. The performance of the incinerator will vary depending on the moisture content of the medical waste but a throughput of up to 15kg/hour can be achieved. The incinerator has been designed and built on site, using standard building bricks and lined with refractory bricks. All the steel components, such as the loading door, the ash removal door and air inlet apertures have been made using basic workshop equipment. Wood and dry waste soaked in kerosene or diesel is required initially to start the combustion process. Once the correct temperature is reached, the medical waste is loaded into the incinerator. Much of the medical waste will have value as a fuel and will contribute towards combustion but additional wood or kerosene may be required to ensure that adequate combustion temperatures are maintained. The initial combustion occurs in the primary chamber and then the hot gases pass into the secondary chamber where the combustion process is completed. The two-chamber design helps to ensure that the combustion time is sufficient to destroy the products of combustion and minimise any harmful emissions. The incinerator is situated under a simple open-sided roofed structure, in an area free from air turbulence. The incinerator is capable of incinerating most types of medical waste including textiles, plastics and packaging. It can also incinerate most types of drugs, medicines, vaccines and sharps – as long as they are mixed with other wastes. However, as grease-based products, such as ointments, creams and Vaseline create large quantities of dense black smoke when burned, they are best disposed of by other means.

2.2 A brief of Diani Beach hospital

Founded in 1997 and with a motto '*Professional Healthcare with a Personal Touch*,' Diani Beach Hospital is the premier private healthcare facility located in the beautiful Diani Beach on the South Coast of Kenya. From the advanced cardiac care ambulance to the state-of-the-art ICU the hospital has taken steps to ensure that patients get medical care on par with some of the top international hospitals. Its range of facilities include outstanding laboratory and imaging services, dental and physiotherapy departments, minor and major theaters, 24 hour doctors on call, and in-patient services.

Picture 1: Entrance to the hopsital

It provides a full range of acute and tertiary services, including 24-hour Accident and Emergency (A&E) services, in-patient services, ambulatory care and rehabilitation services, as well as specialist services covering a wide range of specialties and subspecialties for the residents.

Diani Beach Hospital is committed to delivering international quality and affordable healthcare consistently to its patients. It aims to promote wellness, relieve suffering, and restore health as swiftly, safely and humanely as possible.

2.3 Classification of biomedical waste

Bio-Medical waste can be classified as:-

- ***Infectious waste***:- Waste contaminated with blood and other bodily fluids (e.g. from discarded diagnostic samples), cultures and stocks of infectious agents from laboratory work (e.g. waste from autopsies and infected animals from laboratories), or waste from patients with infections (e.g. swabs, bandages and disposable medical devices)
- ***Pathological waste***:- Human tissues, organs or fluids, body parts and contaminated animal carcasses, Sharps waste Syringes, needles, disposable scalpels and blades, etc.
- ***Chemical waste*** :- Solvents and reagents used for laboratory preparations, disinfectants, sterility and heavy metals contained in medical devices (e.g. mercury in broken thermometers) and batteries;
- ***Cyctotoxic waste***: -Waste containing substances with genotoxic properties (i.e. highly hazardous substances that are, mutagenic, teratogenic or carcinogenic), such as cytotoxic drugs used in cancer treatment and their metabolites;
- ***Radioactive waste***: - Products contaminated by radionuclide including radioactive diagnostic material or radio therapeutic materials;
- ***Pharmaceutical waste***:- Expired, unused and contaminated drugs and vaccines;
- ***Non-hazardous or general waste***: - Waste that does not pose any particular biological, chemical, radioactive or physical hazard.

2.4 Proposed development components

2.4.1 Waste Reception

The waste feeding will be done manually to the incinerator and will be fed directly using labour. The labour(s) who are feeding the waste will wear all required safety PPEs'. This medical waste incinerator will be a simple two-chamber natural-draught incinerator designed to be operated at temperatures of 800o C and higher. The performance of the incinerator will vary depending on the moisture content of the medical waste. The incinerator has been designed and built on site, using standard building bricks and lined with refractory bricks. All the steel components, such as the loading door, the ash removal door and air inlet apertures has been made using basic workshop equipment.

2.4.2 Waste segregation, storage, and transportation of waste

Proper segregation of the bio-medical waste at source, storage, and transportation are required not only to prevent negative health and environmental impacts, but also to maintain resource efficiency and material recovery. In addition, existing operational protocols for bio-medical waste management should be continued for waste, with specific precautionary measures, adjustments, and arrangements applied to mitigate any potential risks and especially at this time the risks of COVID-19 infection in the waste management process.

2.4.3 Waste minimization

The hospital need to work on the concept of the 3Rs (reduce, reuse and recycle). This will be aimed at ensuring better practice of bio-medical waste management to avoid or recover as much of the waste as possible. The most preferred management solution is not to produce the waste in the first place, by avoiding wasteful ways of working. Although waste minimization is widely practiced at the point of its generation, such as separation of hazardous waste from other wastes, a proper plan that adopts purchasing and stock control strategies can also result in a reduction in the amount of waste produced.

2.4.4 Waste segregation at source

Colour coding makes it easier for staff who is handling waste to put waste items into the correct container, and to maintain segregation of the wastes during transport, storage, treatment and disposal. Colour coding also provides a visual indication of the potential risk posed by the waste in a particular container. Some important best practices on waste segregation include:-

- Segregate waste as close to the source as possible (proximity principle);
- Place segregated waste in identifiable, color-coded,
- labeled containers or bags, which are leak-proof and puncture resistant (particularly for sharps);
- Place instructions for proper waste segregation close to the container;
- Use double-layer bags. Waste is to be placed in a specialized bag or container, sealed, and then placed in the second bag or container

2.4.5 Transporting the waste

Onsite transport should take place during less busy times whenever possible. Set routes should be used to prevent staff and patients from being exposed, and to minimize the passage of loaded carts through patient care and other clean areas. Regular transport routes and collection times should be fixed and reliable. General waste should not be collected at the same time, or using the same trolley, as infectious or other hazardous waste. Storage should be located away from patients and public access. It should also be secured properly ventilated and inaccessible to vertebrate pests. Transport staff should wear adequate personal protective equipment, gloves, strong and closed shoes, overalls and masks

2.4.6 Waste Storage

There is a storage provided awaiting incineration. The area is secured to prevent unauthorized access and covered properly. Storage is also provided for tools, records, personal protective equipment and fuel (both kerosene and firewood). In addition the area where the incinerator is located is:

- An enclosure to prevent access by children and unauthorized persons, as well as scavenging animals and birds.
- Made is a way to provide protection from the weather, particularly rain, for the incinerator, the operator, and the waste to be incinerated;
- The shelter should also protect the fuel, the operator's tools, protective clothing, and records.

Picture 2: The brick incinerator installed at the hospital

2.5 Project Specifications

The medical waste incinerator which was installed and designed at the hospital. The medical waste incinerator was made from basic standard size refractory bricks and ordinary

building bricks. Other materials used are mild steel angle bar, sheets and pipes. The features of this incinerator model comprised a simple dual compartment burning zones, natural-draught air inlet opening, a chimney, top-loading and ash removal doors. This model was designed to be operated at temperatures of 800oC and higher. The performance of the incinerator varies and depends on the moisture content of the medical waste (load) but a throughput of up to 12kg/hour is achieved.

The foundation was the first part made on the ground. It was made with normal cement aggregate casted on a 3inch foundation trench. The size was 9 inches slightly larger than the incinerator outer wall body all round with a thickness of 150mm (6inches). A standard concrete mix (3:2:1) aggregate of sand, cement and stones were used. The body of the incinerator was put in place starting with the inner wall, using the fire bricks arranged in line into a three by six bricks matrixes without spacing for mortar. This arrangement was built up to five layers making openings for the position of top loading door access, ash removal door and chimney channels. The outer wall was erected with ordinary building bricks, held in place with cement mortar leaving 5-inches (125mm) air spacing all round the inner wall. The thickness of the fire bricks and that of the outer wall ordinary building bricks, together with the air spacing sufficiently provides resistance to heat loss from the incinerator during operation. The incinerator top was made of 2.5mm steel sheet, prefabricated in a metal workshop, which had openings for the loading door and stack (chimney). It was put in place as an incinerator top covering leaving opening for top-loading door together with a spigot for the flue stack (chimney). The stack was fitted over the top of the incinerator and clamped in position by an angle iron frame and angle iron strips fitted to the outer wall.

The loading door, made from angle iron and small piece of sheet metal, was fitted with a doorframe welded to the top plate. Also welded to the top plate were a number of lengths of angle iron that helped to hold down the top plate and form a box around the stack opening. Air supply channels were pre-fabricated in the metal workshop from 2-inch square pipes cut in lengths of 150mm. This was welded on top of the 220 by 228mm square main frame of the ash door. The air inlet cross- sectional area was designed and measured to be approximately 8200mm2. Charcoal, kerosene and papers were used to initiate combustion inside the Primary burning chamber. After burning had progressed for about 30mins the load which consist of mixed medical waste is added**.**

2.5.1 General Operation

Proper operation will be critical to achieving design parameters. In general, the designer of the incinerator provided operating practices including start-up procedures, shutdown procedures, normal operation, troubleshooting, maintenance procedures, recommended spare parts, etc.

2.5.2 Operating the incineator

These are several recommendations that may apply to various small-scale incinerators:

- The incinerator must be fully heated up before wastes are added, requiring about 30 min or longer, depending on ambient temperature, type of fuel, fuel moisture content, etc.;
- If firewood is uses, it must have a low moisture content (<15%);
- Temperature monitors should be used to be able to determine if suitable temperature have been reached.
    - Grey or black smoke indicates poor combustion and low temperatures.

- Low cost dial type readout temperature sensors should be available for a reasonable cost and it is strongly suggested that units incorporate a quantitative temperature gauge, and that waste only be combusted when the temperature is in the correct range.

- Operation requires the constant presence of an operator when burning waste.
- Dry fuels must be added every 5 – 10 min.
- Flame must not be extinguished during burnings.
- Grates must be regularly checked and raked to keep clear.

2.5.3 Waste Loading

Proper waste loading is critical to achieving combustion.

- Proper amount of fuel should be present (2/3 full) before adding wastes.
- Operator care, judgment, and experience necessary to deal with different load types:
  - Charging every 10 minutes appears to be an optimal rate for charging the incinerator.
  - Very wet loads should be separated with drier material, and in extreme case supplemented by an extra increment of diesel/kerosene.
  - High heat fuels (plastics, paper, card and dry textiles) are helpful to maintain temperature.
  - Waste mixing is desirable. Mixing may be possible by separating waste types at the source in bags, labelling each, and loading in appropriate combination or sequence.
  - Operators should not sort and mix waste prior to incineration due to hazards.
  - Supplemental fuel may be need for wastes with a high moisture content or low fuel value.
  - Restricted wastes should never be burned, including radioactive wastes, mercury thermometers, or hazardous chemicals.
  - Because of the lack of emission controls, wastes containing chlorine, sulphur, nitrogen and toxic metals should be avoided.
- Measures may be necessary to hold wastes in position long enough to burn and to prevent them from failing through grate without being destroyed. This is especially important for smaller wastes, e.g., pills, sharps, etc. Sharps should be mixed with other waste.
- When the loading door is closed or opened rapidly, burning gases may come through the under air ports (air holes).
- Possible operator exposure due to smoke, flames, heat when loading door is opened or rapidly shut.
- The operator should open the door while standing at the front of the incinerator (to protect from blowback), wait a few seconds for any blowback to subside, and load from the side.
- Sufficient time must be provided for the 'fixed carbon' in the waste bed to combust.

2.5.4 Monitoring

Combustion and emission monitoring is used routinely for several purposes, including determining whether incinerators are properly operated. Additionally, monitoring is used to assure compliance with regulatory limits and, to an extent, to help build public trust. Monitoring may be classified into the following categories:

- Sensory observations, e.g., visual assessment of stack emissions or assessment of odours. Sensory monitoring is clearly unable to detect many emissions of concern, and is very subjective.
- Stack tests, e.g., measurement of emissions for brief periods of time. These tests are expensive, and provide emission data for only a brief period of time that may not be representative.
- Continuous emission monitoring, e.g., in-stack monitoring of opacity (particle surrogate), SO_2, CO, O_2, NOx, HCl and recently Hg is regularly conducted at modern incinerators;
- Continuous monitoring of temperature and other parameters (e.g., pressure drop across filters) is also used. Continuous emission monitoring data have been used as surrogates of emissions and to indicate the suitability of combustion conditions, although there are issues, e.g., correlation of CO to products of incomplete combustion is poor at low CO levels.
- Environmental monitoring:-While used infrequently, monitoring of ambient air, soil, food, etc., around incinerators has been used to confirm predictions of multimedia exposure models.

Low-cost and locally-built incinerators have minimal if any capability to monitor operations, including emissions or combustion conditions, other than the use of sensory observations.

2.5.5 Safety

Safety considerations include prevention of infection, equipment safety (to prevent operator injury), and fire safety. Some specific recommendations include:

- Eye protection and a face mask should be worn when opening loading door or visually checking the unit to protect against glass shards from exploding ampoules and glass bottles.
- Heavy-duty gloves and apron should be worn when handling health-care waste;
- Ash must not be handled by hand;
- An adequate cool-down period (3 to 5 hrs) is necessary before ash removal;
- Appropriate disposal of ash is necessary

2.5.6 Management of the incinerator

"Best practices" for small-scale incineration has goals of suitably treating and disposing of waste, minimizing emissions, and reducing occupational exposures and other hazards. Best practices include the following elements:

- Effective waste reduction and waste segregation, ensuring that only the smallest quantity of appropriate waste types is incinerated;
- An engineered design, ensuring that combustion conditions are appropriate, e.g., sufficient residence time and temperatures to minimize products of incomplete combustion;
- Siting incinerators away from populated areas within the facility, thus minimizing exposures and risks;

- Construction following detailed dimensional plans, thus avoiding flaws that can lead to incomplete destruction of waste, higher emissions, and premature failures of the incinerator;
- Proper operation, critical to achieving the desired combustion conditions and emissions, e.g., appropriate start-up and cool-down procedures; achievement and maintenance of a minimum temperature before waste is burned, use of appropriate loading/charging rates (both fuel and waste) to maintain appropriate temperatures, properly disposal of ash, and various actions and equipment to safeguard workers;
- Periodic maintenance to replace or repair defective components, e.g., including inspection, spare parts inventory, record keeping, etc;
- Enhanced training and management, possibly promoted by certification and inspection programs for operators, the availability of an operating and maintenance manual, management oversight, and maintenance programs.

2.5.7 Maintenance

Regardless of how well equipment is designed, wear and tear during normal use and poor operation and maintenance practices will lead to the deterioration of components, a resultant decrease in both combustion quality, an increase in emissions, and potential risks to the operator and public. Operation and maintenance also affect reliability, effectiveness and life of the equipment. Essentially all components of small-scale incinerators are prone to failure and require maintenance. Maintenance on an hourly to semi-annual schedule is required. A typical maintenance/schedule for a small-scale incinerator is shown in the next table.

Table 2.5 : Typical Maintenance Schedule for Incinerators

ACTIVITY	FREQUENCY	COMPONENT PROCEDURE
Hourly	Ash removal	Inspect and clean as required
Daily	Temperature, pollution monitors, if any	Check operation
	Under fire air ports	Inspect and clean as required
	Door seals	Inspect for wear, closeness of fit, air leakage
	Ash pit	Clean after each shift
Weekly	Latches, hinges, wheels,	Lubricate if applicable
Monthly	External surfaces of incinerator and chimney	Inspect external hot surfaces. White spots or discoloration may indicate loss of refractory
	Refractory	Inspect and repair minor wear with refractory
	Upper/secondary combustion chamber	Inspect and remove particulate matter accumulated on chamber floor
Semi-annually	Hot external surfaces	Inspect and paint with high temperature paint as required
	Ambient external surfaces	Inspect and paint as required

For small-scale low cost incinerators, components particularly prone to failure include:

- Firebox access doors and frames that warp, hinges that seize and break, and assemblies that break free of mortar;
- Grates that distort, break, or become clogged;
- Chimneys (stacks) that are badly corroded and chimney supports (guy wires) that are not adequately attached, broken, loose or missing;
- Masonry, bricks and particularly mortar joints that crack;
- Grills damaged or missing;
- Steel tops that warp and short-circuit the secondary combustion chamber;

Incinerators typically require major maintenance after 3 years, costing approximately 70% of initial construction costs. Funds must be made available to provide for both routine and major maintenance.

2.5.8 Facility Inspection

As currently used, stack gases or necessarily even basic combustion process parameters like temperature are not monitored in small-scale incinerators. There is a need for even basic facility inspections to ensure that the unit is in proper repair and that compliance with best operating practices is feasible. Facility inspections should include:

- Visual inspections of the facility for corrosion, leaks, mortar and seal failures, etc;
- Testing of doors and other moving parts;
- Regular schedule, e.g., monthly to quarterly;
- Documentation of use, maintenance, and complaints;
- Reporting of findings to higher authorities.

A trained operator can provide this inspection. Ideally, the Environment Officer advising the hospitl, along with the certified operator, would conduct an inspection twice per year.

2.5.9 Record Keeping

Records must be maintained for maintenance activities to prevent premature failure of equipment, increase life, track performance, evaluate trends, identify potential problems areas, and find appropriate solutions.

2.5.10 Training and Management

Proper operation of incinerators is necessary to minimize emissions and other risks. Only a trained and qualified operator should operate or supervise the incineration process. The operator must be onsite while the incinerator is operating. Without proper training and management support, incinerators cannot achieve proper treatment and acceptable emissions, and the resultant risks due to incineration can greatly increase and may be unacceptable.

The manufacturer or designer of the incinerator should provide operation and maintenance training and provide manuals with specific instructions for their equipment.

An approved program would include the following components:

- Coverage of the following i.e. fundamental concepts of incineration; risks associated with health-care waste and waste incineration; waste reduction, segregation and handling goals and practices; design, operation, maintenance of the specific incinerator used; operation problems and solutions (e.g., white smoke, black smoke, etc.); operator safety and health issues; community safety and health issues; best practices guide for the specific equipment including appropriate fuels, frequency of burns, etc. This will need to be tailored to both the equipment plus waste stream at the site; inspection and permitting; and record keeping (operation and maintenance activities).
- Reference material covering the course.
- Practical training is necessary in addition to classroom training.

2.6 Roles and responsibilities of the incinerator operator

The incinerator operator should:

- Follow the incinerator operations procedure;
- Use protective equipment when handling waste;
- Ensure an adequate supply of fuel is available;
- Record the weight and type of waste received.
- Follow the regular maintenance schedule for incinerator.

2.7 Responsibilities of the supervisor

The supervisor should:

- Provide monthly supervision to incinerator operators using the supervisor's checklist;
- Ensure that there is adequate equipment, tools, and fuel for the incineration process;
- Allocate duties and schedules for incineration to the operators;
- Ensure that waste and ash is disposed of properly;
- Ensure relevant records are up to date.

2.8 The incineration process

Operate the incinerator only

when:

- Enough waste have been deposited.
- The wind is not blowing towards the health facility or other buildings near the incinerator.
- No large groups of people are present in the immediate area.

Start up

Prior to start-up:

- Make sure that there is adequate fuel (wood, coconut shells or other combustible agro waste, and kerosene) available at the incinerator.
- Make sure that the waste stored in the incinerator is dry. If it is wet, place it in a well-ventilated spot inside the WDS to dry.

- Ensure that all tools and equipment are in working order
- Wear personal protective equipment (gloves, goggles, overalls, and masks).

Clean the incinerator

When cleaning the incinerator

- Remove the ash from the incinerator
- Empty the ash into the ash residue pit;
- Be sure to wipe the ashtray off any residue ash with a brush.
- After cleaning, return the ashtray back into the incinerator.
- Clean the lower inside of the incinerator with a brush and dustpan.

During incinerator cleaning, the attendant must:-

- Wear gloves and a facemask when removing the ash.
- Rake the ash and other noncombustible waste directly into the ash pit.
- Replace the trap door of the ash pit to avoid accidents.
- From time-to-time, distribute the ash evenly within the pit.

When receiving the waste, the attendant must:-

- Inspect the waste and ensure that is properly packaged (i.e., categories of health care waste in appropriate waste bags).
- Weigh or count the waste bags and count the safety boxes. Record these quantities in the Waste-Disposal Record;
- Store the waste temporarily in the designated storage area;
- Report any problems to the supervisor.

3.0 LEGISLATIVE AND REGULATORY FRAMEWORK

3.1 Relevant National Legislation & Policies

3.1.1 Constitution of Kenya

The Constitution of Kenya is the supreme law of Kenya. It establishes the structure of the Kenyan government, and also defines the relationship between the government and the citizens of Kenya. The current Kenyan constitution was enacted on 27th August 2010, replacing the older one that had been in place since Independence in 1963.

The Kenyan Constitution has a preamble, 18 chapters and six schedules. The preamble affirms the acceptance by all Kenyans to adopt the constitution for themselves and for all future generations. Among other functions, the six schedules describe the national symbols of Kenya and also prescribe the oaths of office for holders of different constitutional offices. Chapter four of the Constitution - The Bill of Rights Article 42 states that: 42. Every person has the right to a clean and healthy environment, which includes the right—

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

(b) to have obligations relating to the environment fulfilled under Article 70.

Chapter five of the Constitution – Land and Environment Article 69 states that:

(1) The State shall—

(a) Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;

(b) Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;

(c) Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;

(d) Encourage public participation in the management, protection and conservation of the environment;

(e) Protect genetic resources and biological diversity;

(f) Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;

(g) Eliminate processes and activities that are likely to endanger the environment; and,

(h) Utilize the environment and natural resources for the benefit of the people of Kenya.

(2) Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

3.1.2 Legal and Regulatory Instruments in Kenya

Applications of national statutes and regulations on environmental conservation suggest that the proponent has a legal duty and responsibility to discharge wastes of acceptable quality to the receiving environment without compromising public health and safety. This position enhances the importance of an EA for the project to provide a benchmark for sustainable operation of the apartments when it is fully operational. The key national laws that govern the management of environmental resources in the country have been briefly discussed in the following paragraphs. Note that wherever any of the laws contradict each other, the amended EMCA (2005) prevails.

3.1.3 Environmental Management and Co-ordination (Amendment) Act, 2015

The Environmental Management and Co-ordination (Amendment) Act, 2015 updated the 1999 Environment Management and Co-ordination Act (EMCA), which provides for the protection and conservation of the environment. The proposed project will be undertaken in accordance with relevant sections of EMCA, specifically Clauses 58 – 63. These sections of the Act are operationalized by subsidiary legislation promulgated under the Act. Under EMCA, project proponents are required to undertake an environmental impact assessment prior to starting any project specified in the Second Schedule of the Act.

3.1.4 The Water Act, 2016

An Act of Parliament to provide for the regulation, management and development of water resources, water and sewerage services; and for other connected purposes. This Act provides for the regulation, management and development of water resources and water and sewerage services in line with the Constitution. Authorities shall, in administering or applying this Act, be guided by the principles and values set out in Articles 10, 43. 60 and 232 of the Constitution. it establishes the Water Resources Authority ("Authority"), the National Water Harvesting and Storage Authority, the Water Services Regulatory Board, the Water Sector Trust Fund and the Water Tribunal. The Water Resource Management Rules also provide requirements for the design of a hydropower project, including for project design and construction supervision, dam freeboard, a mechanism for compensatory flow and acceptable return period for the spillway. It will be important to get an early indication of the volume of water abstraction that may be permissible at the project site as this may affect the design flow and thus the project engineering, costs and power generation.

3.1.5 The Penal Code (Cap. 63)

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

3.1.6 The Occupational Safety and Health Act, 2007

The Proponent and Proponent are advised to strictly adhere to the provisions of OSHA 2007 especially during the operational phase. This is an act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. They should be strictly observed during the operational phase. The key areas addressed by the Act include but not limited to:

I) General Duties including duties of occupiers, self-employed persons and employees
ii) Enforcement of the act including powers of an occupational safety and health officer
iii) Health General Provisions including cleanliness, ventilation, lighting and sanitary conveniences
iv) Machinery safety including safe handling of transmission machinery, hand held and portable power tools, self-acting machines, hoists and lifts, chains, ropes & lifting tackle, cranes and other lifting machines, steam boilers, air receivers, refrigeration plants and compressed air receiver
vi) Safety General Provisions including safe storage of dangerous liquids, fire safety, evacuation, precautions with respect to explosives or inflammable dust or gas
vii) Chemical safety including the use of material safety data sheets, control of air pollution, noise and vibration, the handling, transportation and disposal of chemicals and other hazardous substances materials
viii) Welfare: general provisions including supply of drinking water, washing facilities and first aid
ix) Offences, penalties and legal proceedings
Under section 6 of this act, every occupier is obliged to ensure safety, health and welfare of all persons working in his workplace. The occupier shall achieve this objective by preparing and as often as may be appropriate, revising a written statement of his general policy with respect to the safety and health at work of his employees and the organization and arrangements for the time being in force for carrying out that policy (Section 7).
Section 78 (5). Furthermore, a clear and bold notice indicating that smoking is prohibited should be conspicuously displayed in any place in which explosive, highly flammable or highly combustible substances, are manufactured, used, handled or stored-section
Section 81 states that necessary precautions for dealing with fire incidents should be implemented including provision of means for extinguishing fire and means for escape, in case of fire, for the persons employed in any workplace or workroom –. As far as disaster preparedness and emergency response program is concerned,
Section 82 (1) makes it a mandatory requirement for every occupier of a workplace to design evacuation procedures to be used during any emergency situation and to have them tested at regular intervals.
Section 95 of OSHA 2007 The employers' positive contribution towards the welfare of the employees include provision and maintenance of adequate supply of wholesome drinking water while - section 91 states that a first aid box or cupboard of the prescribed standard at suitable point(s) Conveniently accessible to all employees.
Section 96 (1) of OSHA also includes: issuance of a work permit to any employee, likely to be exposed to hazardous work processes or hazardous working environment, including such work processes as the maintenance and repair of boilers, dock work, confined spaces, and the maintenance of machinery and equipment, electrical energy installations, indicating the necessary precautions to be taken.

3.1.7 Physical Planning Act, 2007 and Physical Planning Bill, 2015

Section 24 and 29 of the Physical Planning Act gives provision for the development of a local physical development plan to guide and coordinate development of infrastructure facilities and services within the area of authority of a County Government and for specific control of the use and development of land. The Act also decentralizes approval of all development applications and granting of development permissions oversight of the proper execution and implications of approved physical development plans. Site building planning permission in the form of an Installation License will need to be obtained from the Physical Planning Department of the Local Authority (County Government), under section 30 of the Physical Planning Act (Cap 286). The Physical Planning Bill, 2015, further stresses the importance of controlled development in accordance with county and national physical planning. County approval for change of user is required and the county may decide to charge fees for developments where change of user is required. In certain cases the change of user requires the amendment of the County physical plan, which entails public consultation. Similar procedures are to be applied for way-leaves for electric distribution infrastructure as such have to be integrated in the county physical planning and thus require county approval.

3.1.8 Environmental Vibration Pollution (Control) Regulations, 2009

These regulations were published as legal Notice No. 61 being a subsidiary legislation to the Environmental Management and Co-ordination Act, 1999. The regulations provide information on the following:

- Prohibition of excessive noise and vibration
- Provisions relating to noise from certain sources
- Provisions relating to licensing procedures for certain activities with a potential of emitting excessive noise and/or vibrations and
- Noise and excessive vibrations mapping

3.1.9 County Government Act 2012

This Act gives effect to Chapter Eleven of the Constitution, which provides the county governments the powers to function and take responsibilities for the delivery of services within their designated counties including management of environment and natural resources among other responsibilities. The functions provided for in Article 186 of the constitution and as assigned in the Fourth Schedule of the Constitution. These include management of water resources, biodiversity, forests, and National Reserves among others.

According to regulation 3 (1), no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment.

Regulation 4, prohibits any person to *(a)* make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or *(b)* cause to be made excessive vibrations which exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

Regulation 5 further makes it an offence for any person to make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.

3.1.10 The Work Injury Benefits Act (2007)

Work Injury compensation Benefit Act 2007 This Act provides guideline for compensating employees on work related injuries and diseases contacted in the course of employment and for connected purposes. The act includes compulsory insurance for employees. The act defines an employee as any worker on contract of service with employer. This Act is triggered by the proposed project thus it is recommended that all workers contracted during the project implementation phase have the required insurance covers so that they can be compensated in case they get injured while working.

3.1.11 The Way Leaves Act Cap 292 3.10

According to the Way Leaves Act cap 292 Section 2, private land does not include any land sold or leased under any Act dealing with government lands. Section 3 of the Act states that the government may carry any sewer, drain or pipeline into, though, over or under any lands whatsoever, but in so doing may not interfere with any existing building. Section 8 further states that any person who, without the consent of the Permanent Secretary to the Ministry responsible for works (which consent shall not be unreasonably withheld), causes any building to be newly erected over any sewer, drain or pipeline the property of the Government, shall be guilty of an offence and liable to a fine of one KSh 150, and a further fine of KSh 60 for every day during which the offence is continued.

The Principal Secretary in the ministry may cause any building erected in contravention of this section to be altered, demolished or otherwise dealt with as he may think fit, and may recover any expense incurred by the Government in so doing from the offender.
The developer will be expected to undertake the process of construction of various structures of project in compliance with this Act.

3.2 Non regulatory framework

3.2.1 Kenya Vision 2030

Following the expiry of the Economic Recovery Strategy (2003-2007), Kenya's Development Agenda is now anchored on the Kenya Vision 2030, which aims at creating "a globally competitive and prosperous country with a high quality of life by 2030". It aims to transform Kenya into "a newly – industrialized, middle-income country providing a high quality of life to all its citizens in a clean and secure environment". Simultaneously, the Vision aspires to meet the Sustainble Development Goals (SDGs) for Kenyans by 2030. The Vision is anchored on three key pillars: economic, social and political. The economic pillar aims was to achieve an average economic growth rate of 10 per cent per annum by 2012 and sustaining the same till 2030 in order to generate more resources to meet the SDGs and Vision 2030 goals. The social pillar seeks to achieve a just, cohesive and equitable social development in a clean and secure environment, while the political pillar aims for a democratic, issue-based, people-centered, result- oriented and accountability system. The proposed project falls under the first pillar-fostering economic growth.

- Other than what is contained in various statutes and policies, the report encourages the adoption of best practices on environment, trade, employment and resource usage among others. Such practices include the following;
- Prevention of erosion and resultant siltation of water bodies.

- Reduction of dust generation and exposure to the community by use of water even on the roads.
- Timely payment of salaries to workers and advances when needed.
- Fencing of exposed dangerous areas.
- Taking measures to prevent employee's physical harassment and exploitation.
- Bridging the communication gap between the local and expatriate staff.

3.2.2 Principles of Sustainable Development

Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations.

a) Sustainability

The principle of sustainability requires that natural resources should be utilized in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. It strives for equity in the allocation of the benefits of development and decries short-term resource exploitation which does not consider the long-term costs of such exploitation.

b) Principle of intergenerational equity

The principle of sustainability should be examined together with that of intergenerational equity, which focuses on future generation as a rightful beneficiary of environmental protection. Essentially, the principle of intergenerational equity advocates fairness, so that present generations do not leave future generations worse off by the choices they make today regarding development. Its implementation requires the utilization of natural resources in a sustainable manner while avoiding irreversible environmental damage.

c) Principle of prevention

The principle of prevention states that protection of the environment is best achieved by preventing environmental harm in the first place rather than relying on remedies or compensation for such harm after it has occurred. The reasoning behind this principle is that prevention is less costly that allowing environmental damage to occur and then taking mitigation measures.

d) Precautionary principle

The precautionary principle recognizes the limitations of science, as it is not always able to accurately predict the likely environmental impacts of resource utilization. It calls for precaution in the making of environmental decisions where there is scientific uncertainty. Accordingly, it is closely related to the principle of prevention and can be viewed as the application of the principle of prevention where the scientific understanding of a specific environmental threat is not complete. The precautionary principle thus requires that all reasonable measures must be to prevent the possible deleterious environmental consequences of development activities. Further, it demands that scientific uncertainty should not be used as a reason for not taking cost-effective measures to prevent environmental harm.

e) Polluter pays principle

The polluter pay principle requires that polluters of natural resources should bear the full environmental and social costs of their activities. It seeks to internalize environmental externalities by ensuring that the full environmental and social costs of resource utilization are reflected in the ultimate market price for the products of such utilization. Since environmentally harmful products will tend to cost more, this principle promotes efficient and sustainable resource allocation as consumers are likely to prefer to the cheaper less polluting substitutes of such products.

f) Principle of public participation

The principle of public participation seeks to ensure environmental democracy and requires that the public, especially local communities should participate in the environment and development decisions that affect their lives. It requires that the public should have appropriate access to information concerning the environment that is held by public authorities and should be given an opportunity to participate in decision-making processes

4.0 OCCUPATIONAL HEALTH AND SAFETY

This chapter covers various aspects of occupational health, safety, and security at the incinerator site including personal protective equipment, safety measures, and what to do in case of needlestick injury.

4.1 Personal Protective Equipment

The operator should always have adequate personal protective equipment (PPE). This equipment must be worn at all times when working with health care waste. It is also important the equipment is properly maintained and kept clean. The equipment should not be taken home; it must remain at the health facility to avoid possible spread of infection to the community.

Standard PPE generally includes:

- ***Gloves***: Always wear gloves when handling bio-medical waste.
- ***Puncture-resistant gloves***: should be used when handling sharps containers or bags with unknown contents. Heat-resistant gloves should be worn when operating the incinerator.
- ***Boots:*** Safety boots or leather shoes provide extra protection to the feet from injury by sharps or heavy items that may accidentally fall. Boots must be kept clean.
- ***Overalls:*** Overalls should be worn at all times;
- ***Aprons:*** Heat-resistant aprons should be worn when operating the incinerator;
- ***Goggles:*** Clear, heat-resistant goggles can protect the eyes from accidental splashes or other injury;
- ***Mouth respirators***
- ***Helmet***: Helmets protect the head from injury and should be worn at all times during the incineration process.

4.2 Operator safety measures

Some of the safety measures that need to be taken by the incinerator attendant include:-

4.2.1 Hand hygiene

Having clean hands, along with the hand washing accessories to ensure clean hands, is one of the oldest, most well known methods of preventing disease transmission. Incinerator operators should always clean their hands after handling it.

4.2.2 Medical examinations

The incinerator operator should be medically examined prior to initial employment and undergo regular medical examinations every 6 months. The operator should also be immunized for Tetanus and Hepatitis B

4.2.3 Emergency response

Fire safety

Proper fire safety equipment should be provided at the incinerator site. Types of safety equipment recommended include standard fire extinguishers, sand buckets, and water. The operator should read and understand the procedures on the fire extinguisher and use them in the event of a fire. Flammable material should be safely stored away from the incinerator. A protective cover should be present at the spigot (lower part of chimney) to protect the operator from burns from the high heat generated at this point. Operators should secure the fire chamber door and waste loading door so they do not accidentally open and allow the fire to spew out.

Steps to follow in case of accidental spillage of infectious waste

- Determine the nature of the spill;
- Limit the spread of the spill;
- Secure the area to prevent exposure of additional individuals;
- Provide first aid and medical care to injured individuals;
- Decontaminate the eyes and skin of exposed personnel immediately;
- Report the spill to the designated person who should coordinate the necessary actions.
- Provide adequate protective clothing to personnel involved in cleaning up;
- Neutralize or disinfect the spilled or contaminated material if indicated;
- Collect all spilled and contaminated material;
- Sharps should never be picked up by hand;
- brushes and pans or other suitable tools should be used.
- Decontaminate or disinfect the area, wiping up with an absorbent cloth. Rinse the area and wipe dry with absorbent cloth;
- The type of disinfectant recommended is Sodium Hypochlorite (Jik).
- Decontaminate or disinfect any tools that were used.
- Spilled material and disposable contaminated items used for cleaning should be placed in the appropriate waste bags or containers.
- Remove protective clothing and decontaminate or disinfect it if necessary. Seek medical attention if exposure to hazardous material has occurred during the operation.

4.2.4 Security at the incinerator site

- Entry to the incinator site should be restricted;
- Keep the incinerator site locked at all times;
- Do not allow unauthorized persons to enter the incinerator area during periods of incineration;
- Immediately report any vandalism, theft, or unauthorized entry to the waste-management supervisor;

5.0 DESCRIPTION OF THE RECEIVING ENVIRONMENT

This chapter provides a description of the receiving environment within the study area. This description has not been informed by any specialist studies undertaken for this assessment but includes information attained from various literature sources and is described at a level deemed appropriate for a Scoping study. Additional detailed information will unfold in the EIA phase.

Three components to the environment are recognized:

- Physical Environment;
- Biological Environment; and
- Socio-Economic Environment.

Only those elements of the environment that have a direct bearing on the impact assessment process of the project are discussed. The severity of the potential impacts is largely determined by the state of the receiving environment. For example, the construction of a housing development in a pristine wetland habitat would have far more significant ecological impacts than the construction of a housing development in a residential area.

5.1 Physical Environment

Ukunda is an upcoming urban settlement in the Southern part of the coastal region of Kenya. The area is located in both Msambweni and Kwale districts. It lies approximately 25 kilometers south of Mombasa town along the A14 Mombasa- Lunga Lunga highway. Over the recent couple of years the area has experienced rapid growth in physical development and population. This trend in growth has mostly affected the Ukunda part that caters for population spill-over from Mombasa city and Diani's hospitality sector.

Some of the main areas of Ukunda include: Kombani, Kinondo Vinuni Diani Beach, to Galu Kinondo. The major features within this area include the Mwachema River, Kongo Mosque, various Kayas-including Kaya Tiwi, Kaya Diani, Kaya Ukunda, Kaya Kinondo and Kaya Muhaka. The area also has several existing urban nodes including Ukunda, Diani, Tiwi, and Kombani.

5.1.1 Land

Land in the planning area is classified into government and private. Over 95% of the land is private while 5% is public. Public land available has been committed to public schools, health and other facilities. Private land is held under two tenure systems; freehold and leasehold. Leasehold land mainly falls between the Indian Ocean beach club and Mwaepe fish landing site along the second raw beach road and the Tiwi beach block along the coastline. The rest of the land is freehold. Development within the leasehold area especially Diani depicts a degree of orderliness with high value hospitality developments in the form of high class hotels and villas. The good/best practices can be borrowed in the formulation of the Diani /Ukunda zoning plan. In the freehold area especially Ukunda, sporadic and haphazard developments are the norm. In the same area uncontrolled, inappropriate and uneconomical sub-divisions are widespread

5.2 Physical infrastructure

5.2.1 Energy

The main sources of energy in the area are; electricity, wood fuel and petroleum and products (Kerosene). Electricity is mainly supplied from the national grid. Ukunda area receives electricity from Rabai and Kipevu stations via 33Kv transmission line to the western edge of the planning area in a South - North direction. This line feeds into three substations in the area; Ukunda, Mwabungo and Makongeni. Currently, approximately 10,000 households are connected. This represents 35.5% of the total number of households. Despite connection, electricity supply is inadequate and unreliable as depicted by frequent power disruptions.

5.2.2 Water Supply

There are two sources of water supply which are all ground water based. Tiwi aquifer has coverage of 20 km^2 with good quality of water. It has a through flow of 42000m^3/hr. This reduces to 25000m^3/hr to the north of Ng'ombeni due to decrease in permeability (National Water Master Plan Study, 1992). Of the total capacity only 20000m^3/day is abstracted through shallow wells and boreholes operated by National Water Conservation and Pipeline Corporation and the water shared between Likoni, Tiwi, Diani and Ukunda areas.

Ukunda is supplied from the Tiwi boreholes, shallow wells, and piped system. Water sources have adequate quantities to satisfy demand for the entire Diani/Ukunda. However, the town experiences water shortages due to inadequate supply. The Tiwi aquifer is an important water source in the plan area and needs regulations and standards for its preservation and conservation. The current water supply is 5,000 m^3/day while the demand is 13,500 m^3/day indicating a deficit of 8,500 m^3 per/day. Projected demand at the end of the plan period is 15,200m^3/day. The water demand is derived from the consumption of 650 litres per day for hotels and 135 litres per person per day for the rest of the population. The existing water reticulation system is laid along the Ukunda/Lunga-Lunga road. This system serves the hotels and is a base for secondary reticulation system serving the entire planning area. The supply for the entire area needs to be up scaled.

5.2.3 Sewerage System

Ukunda has no conventional sewerage disposal system. The disposal system is through pit latrines. Given the porosity of the underlying rock, this method of disposal is unsuitable as it may pollute the underground water. There is a plan to identify a suitable site for development of a modern sewage disposal system and prescribe standards for development of the same.

5.2.4 Solid Waste Management

Picture 3: Waste cubicle and bin at Ukunda

Picture 4: Bins now placed at strategic places within the county

5.2.5 Storm Water Drainage

There is no storm water drainage system in Diani/Ukunda. Storm water drains onto the existing road system. This makes these roads impassable during the rainy season. Where roads have been blocked, like in Ukunda, it culminates into floods.

5.3 Biological Environment

5.3.1 Vegetation

In Ukunda, there exist pockets of tropical forests namely Kaya Diani, Kaya Ukunda, Kaya Kinondo, Kaya Muhaka and Robinson forest. These Kayas are listed as world heritage sites by UNESCO and also provide green places in Diani/Ukunda

5.3.2 Soil

At the proposed site the underlying rock of is predominantly limestone which can support permanent multi-storey structures.

5.3 Socio-Economic Environment

5.4.1 Education

From the existing population of 99,701 the area requires 25 public primary schools and 13 public secondary schools. By the year 2017 the projected population will be 111,779 expected primary schools will be 39 and secondary schools will be 14. There exist 22 public primary schools, 7 secondary schools and one village polytechnic. The shortage and poor distribution of primary schools has led to establishment of private schools some of which hardly meet the basic standards of infrastructure. Schools offering specialized education do not exist in the area. It is envisaged that at the end of the plan period an additional 17 primary and 1 secondary schools will have to be provided.

5.4.2 Health facilities

Ukunda having an existing population of 99,701 requires a public hospital for specialized services. Currently, there exist three private high cost hospitals namely; Diani beach Hospital, Palm Beach Hospital and the Varkaat Hospital which offers Ear, Nose and Throat services. These facilities are not affordable to the majority population given their levels of income. Besides the above, there are one sub-district hospital in Tiwi (Tiwi Sub-District Hospital), two health centers and three dispensaries.

5.4.3 Population dynamics

5.4.3.1 Population Size and Growth Trends

The 2009 Population census gives the population in the area as 91 507 persons. The population figure covers the locations of Diani, Kinondo and Tiwi.

5.4.3.2 Distribution and Structure

Of the total population, 46 899 are Males while females are 44 608 giving a sex ratio of approximately 1:1. This is a ratio typical in most urban setups where the male population is slightly higher than the female.

This population concentrates in Gombato sub location with densities of 2271 persons per square kilometre and registers a low of 215 persons per square kilometre in Kinondo sub location an area that is still rural. The urban population in the area is concentrated along the major transportation corridor (Mombasa-Lunga-Lunga road) forming a linear pattern. The current household numbers stand at 28,239 households growing at a rate of 3.27% exponentially.

In 1999 Diani and Ukunda had a population of **42,517** and by 2012 the population will have grown to **99,701**. This signifies a percentage increase of 134.5%. The existing population trends indicate that it doubles after a period of ten years. This is due to increased tourism activities, trade, immigration (local and international) and change of boundaries. The population occurs in the urbanized areas of Diani and Ukunda and their fringes and in the urban nodes namely; Tiwi, Kinondo and Mbongwe and Kona ya Musa.

The rapid growth in population has led to high demand for land, housing, public utilities, facilities and infrastructure. It has led to encroachment on environmentally fragile and conservation areas. Consequently the high demand for the above services coupled with no plan to guide development, has resulted in urban sprawl, informal settlements and haphazard developments.

5.4.3.3 Trends in Tourism

Tourist population has generally been on the rise in the coastal area over the years. For instance in 2004, arrivals at Moi International Airport based on chartered flights stood at 188,927 tourists while in 2010 the figure was 228,029 tourists. This was an increase of 17% in 6 years. Two categories of tourists visit the area: local and international tourists. The local tourists account for 40% while international tourist account for 60% (ministry of tourism). The increase has resulted in increased demand for hotels and related activities such as entertainment spots and supporting infrastructure. Currently there are 75 world class tourist hotels and 54 villas in Diani with a total of 8230 beds. This means Diani tourist facilities account for roughly 27% of the national tourist facilities-8230 bed spaces out of the 30000 nationwide. This makes Diani an important tourist destination in Kenya.

The increasing population and tourist activities necessitate the isolation/identification of segregated land use zones, setting of standards and regulations to control urban sprawl and haphazard developments, protection of existing tourist assets, setting of regulations for their use, and standards for increased investment in infrastructure to support tourism and business activities.

5.4.4 Economic activities

5.4.4.1 Tourism

This is the main economic activity as a result of the thriving hospitality industry concentrated along the shoreline and the various tourist attraction sites. These sites include; the sandy beaches, forests (Kayas), Swahili culture and architecture and historical monuments such as the Kongo Mosque. These tourist assets need to be mapped and standards set for their management, preservation and development.

5.4.4.2 Commerce and Trade (modern, informal financial services, ICT)

Most business activities are concentrated in Ukunda. Various categories of businesses exist and include both merchandize and services. These consist of retail shops, wholesale, kiosks, banks, hotels and communication bureaus. In Diani, shopping centers are also found along the beach road such as Diani shopping Centre, the Bazaar, near Diani Hospital and White House. From the Ukunda junction to Diani Beach road, the dominant commercial activities include supermarkets, hardware and restaurants.

5.4.5 Industry

5.4.5.1 Light industry

The light industrial activities identified include cottage industry, workshops, go downs, petrol service stations, garages and jua kali sheds and small scale processing. These industries are situated variously within the commercial areas of Ukunda due to lack of designated sites/zones for light industry. In some areas they cause incompatibility of land uses.

5.4.5.2 Manufacturing

There are two manufacturing industries: Kenya Bixa Limited located near Tiwi that manufactures paint and Coconut Company Limited located in Mivindeni.

5.4.5.3 Agriculture

This takes place mainly within hinterlands of Ukunda area such as Tiwi and Galu west. Crops grown in these areas include cassava, coconuts, mangoes and cashew nuts. Agriculture mainly takes place in the interior West. To the East, soils are shallow and covered with corals hence limited agricultural activities. Urban sprawl, an effect of rapid population growth in the area, is leading to depletion of agricultural land. Hence, there is need to preserve agricultural land by curbing urban sprawl.

5.4.5.4 Fishing

Fishing activities take place within the Indian Ocean by locals mainly for subsistence. This is due to lack of equipment to enable them venture into deep sea fishing. The fish landing sites in the area include Mwaepe, Mwakamba, Kaya Tiwi, Kinondo and Chale. There is potential for large scale fish production with empowerment of fishermen, for instance, provision of equipment and associated infrastructure.

5.4.5.5 Transportation

The most common mode of transport in area is road with public transport being limited to classified/main roads. The major means of transport includes matatus, tuk tuks, boda boda and taxis.

5.4.5.6 Roads

There are two categories of roads in Ukunda area: classified and unclassified.

The classified roads include the primary route of Likoni to Lunga-Lunga A14 road, which also links Mombasa to Tanzania which is 21.72 Km long and which is tarmacked. It forms the main trunk line which is fed by several connectors. This road divides Ukunda town into two distinct parts. Its accessibility has attracted linear development on both sides of the road which has reduced the road into an access road to abutting properties posing danger to both human and vehicle traffic.

The other classified roads are Kombani – Vinuni (tarmacked, 5.69Km), Tiwi – Vinuni (Murram, 6.3 km), Kona ya Musa – Shamu – Muhaka - Mwabungo, (Murram, 6.0 Km), Msikitini – Bongwe – Shamu, (Murram, 3.1Km) and Darling – Bongwe (Murram 2.14km).

The unclassified Roads include the Ukunda – Diani road, 2.36km which dissects the town into the Northern and southern parts. This road branches from the Likoni – Lunga-Lunga primary road at Ukunda and runs east wards towards the Indian Ocean. The entire stretch is tarmacked up to the junction with the beach access road. It is lined on both sides with residential and commercial developments without any side access lane to provide access to properties.

The other major unclassified road is the Beach Road. Ideally this road should serve as a distributor and collector of traffic emanating from the off and on shore activities. Due to lack of a beach road in Diani, this road is now referred to as the beach road. It is a 15.8 kilometre stretch of which 12.2Km is bitumen and 3.6 kilometres is all weather of murram surface. The road does not have access lanes hence it provides access to individual plots. The Beach road runs northwards from Neptune hotel and ends at Kongo Mosque in the North. Ideally this road should extend beyond this point across Mwachema River to Tiwi in order to offer better connectivity.

5.4.5.7 Air Transport

The Ukunda Airstrip forms the major air transport link from Ukunda to both local and international destinations. The airstrip has a runway of 1.2 km which allows light aircrafts only. It is built on a 37.21 ha piece of land that has been greatly encroached on. It receives about 10 light aircrafts daily. Its location, in the middle of the plan area, in a fast urbanizing environment, has greatly compromised its safety standards and expansion.

5.4.5.8 Water Transport

This is a mode that is not well provided for and developed in the area despite access to the ocean. Water transport is mainly for local fishermen who use small canoes for fishing purposes, sporting activities like scuba diving, sport fishing and wave surfing. The beach landing sites are equally underutilized.

6.0 PUBLIC PARTICIPATION

Interviews were carried out in the neighbourhood in addition to the questionnairs administered, to find out all the views from the neighbours' towards the proposed construction project. There was no objection to the establishment of the project.

6.1 Consultation with interested and affected parties

Consultations were done to interested and affected parties especially the patients and neighbours of the hospital.

Issues raised during consultationsminclude:-

- A waste-incineration facility may provide jobs, both directly and by attracting industry to the region because of the services offered by the facility;
- An incineration facility might also affect property values in its vicinity. Whether it increases or decreases them will depend primarily on what the neighborhood was like before the facility was introduced;
- People in the surrounding area may be psychologically affected by the prospect or reality of an incineration facility in their midst. The risk associated with industrial activity is increasingly recognized as including a wide array of adverse and sometimes long-lived psychological impacts;
- Burning of green waste is difficult to burn and smokey;
- Breathing in wood smoke can cause a number of serious respiratory and cardiovascular health problems;
- operation may increase respiratory illnesses in the area;
- Possible smoke will be detrimental to the health of the residences that live close to the development;
- Waste incineration may be a source of waste pollution.

6.2 The Questionnaire

A questionnaire was administered to the staff and patients at the hospital. The questions asked were:-

1. Do you welcome this project in the area?;
2. List any potential positive impacts the project will bring to the area.
3. Are there issues you would advice to be considered in the operation of the incinerator?;
4. What challenges / problems associated with incinerator operations can you suggest for improvements?
5. Do you foresee any negative impacts? ((If yes, list them)
6. Are there any materials in view that should not be incinerated at the hospial which might cause ill health, or raise environmental concern or actual perceived risks to the people
7. In your opinion is the incinerator compatible with the hospital operations and the area
8. Any additional comments?.

6.2.1 Summary of responses from the questionire

1. Do you welcome this project in the area?
   - All the responds answered on the positive.

2. List any potential positive impacts the project will bring to the area.

- Disposal of waste will be made more efficient;
- This will make the environment clean;
- It will be a better way of dealing with some waste;
- Sharps will be better managed;
- It will a good poluution control;
- Hygiene will will be promoted;
- Waste will be reduced.

3. Are there issues you would advice to be considered in the operation of the incinerator?;
   - Fear of smell if parts of human body is incinerated;
   - Fear of patients and staff;
   - Smoke;
   - Injuries;
   - Reach of children;
   - Incinerator waste polluting even more;

4. What challenges / problems associated with incinerator operations can you suggest for improvements?
   - Possibility of incinerating unrecommended waste;
   - Disorganization of the operation;
   - Smoke;
   - Possible injuries;
   - Safety of people may be compromised;

5. Do you foresee any negative impacts?
   - Possible smell;
   - Residual waste;
   - Possible fumes;
   - Possibilibity of a smoke;
   - Waste from incineration;

6. Are there any materials in your view that should not be incinerated at the hospial which might cause ill health, or raise environmental concern or actual perceived risks to the people
   - Parts of human body;
   - Explosives

7. In your opinion is the incinerator compatible with the hospital operations and the area
   - All the responds answered on the positive.

7.0 ENVIRONMETNAL IMPACTS IDENTIFICATION

7.1 Identification of Impacts

In this chapter, an endeavor has been made to identify various environmental impacts associated with the operation of facility and other activities wherein, there may be a chance of pollution. Based on the possible worst case emissions and waste generation from the proposed project and also taking into consideration the baseline environmental status at the proposed project site, the environmental factors that are likely to be affected (Impacts) are identified, quantified and assessed. Both instrumental (positive) and detrimental (negative) impacts are accounted for this purpose. The prediction of impacts helps in the preparation of a sound environmental management plan which has to be executed during the on-going activities for the proposed project to minimize the adverse impacts on the environmental quality.

7.2 Positive impacts

7.2.1 Decreases Quantity of Waste

Incinerators can decrease the quantity of waste by 95% and reduce the solid quantity of the original waste by 80-85% depending on the components that were in solid waste. Therefore incineration reduces the dependency on dumpsites. Hence, even though incinerators do not completely get rid of dumping ground, they definitely decrease the quantity of land needed. For facilities like Diani Beach Hospital that are small in size and with a shortage use of an incimeatoe is very useful.

7.2.2 Efficient Waste Management

Incineration plays a vital role in making waste management easier and more efficient. Incineration can burn up to 90% of the total waste generated and sometimes even more.

7.2.3 Reduction of Pollution

Incineration rreduces the volume of solid waste, to reduce the potential infectious properties and volume of medical waste, and to reduce the potential toxicity and volume of hazardous chemical and biological waste.

7.2.4 Saves on Transportation of Waste

The presence of an incineration means that waste does not have to be driven for long distances for dumping. It significantly reduces the cost of transport; the money can then be spent on other uses at the hospital. Additionally, it reduces the harmful gases released by vehicles during transportation, thus drastically reducing the overall carbon footprint.

7.2.5 Eliminates Harmful Germs and Chemicals

Incineration function at very high temperatures that can destroy germs and chemicals that are harmful. Thus, it is a very effective method when it comes to eliminating clinical waste.

7.2.6 Occupies Relatively Small Space

Incineration systems occupy relatively small space. Therefore these are a convenient and practical solution for managing waste.

7.2.7 Uncontaminated Groundwater

Unlike dumpsites, incineration doesn't add any toxic elements to the groundwater. Also, it helps prevent leakage of chemicals from dumpsites into the environment, and the soil getting averted

7.3 Negative impacts

7.3.1 Water Environment

No impact on water environment expected. Main sources of wastewater include: Wastewater generated from container washing, floor washing, and from Air Pollution control Devices (APCDs) connected to the incinerator. There will not be any impact on water environment, because all the wastewater will be treated and reused within the facility premises.

7.3.1.1 Mitigation measures

If wastewater is let out without treatment, quality of nearby surface water bodies and groundwater may be impacted. It is proposed to maintain the proposed facility as 'Zero Discharge' facility.

7.3.1.2 Impact management

Storm water drains shall be provided throughout the facility and are connected to the septic tank.
Also, the domestic wastewater will be sent to septic tank followed by soak pit.

7.3.2 Land environment

No impact on land environment expected. Soil quality may be affected If incineration ash, biomedical waste etc. are not stored properly. No impact on land environment

7.3.2.1 Mitigation

With proper storage facilities and disposal mechanisms, no impact on land environment expected

7.3.2.2 Impact management

Waste such as incineration ash generated in the process of incineration shall be stored in a separate area under shed so as to avoid entry of rain water during the monsoon. Incineration ash shall be collected by NEMA authorized waste collector for ultimate disposal. Biomedical waste shall be stored strictly as per waste Regulations. With these measures it is anticipated that there will not be any impact on land environment.

7.3.3 Noise

No significant impact on noise environment expected. Source of noise in proposed project will be from unloading of bio-medical waste, incinerator, motors etc

7.3.3.1 Mitigation

Confined to the project area and is expected to be negligible outside the project boundary.

7.3.3.2 Impact Management

Adequate measures for noise control shall be taken at the design stage itself, such as keeping high noise generating equipment like pumps, motors on anti-vibration pads, placing the equipment in closed rooms. All the equipment shall be regularly maintained. Employees will be provided with PPE like ear plugs, helmets, safety shoes, etc. as necessary.

7.3.4 Air pollution

Air pollution from onsite incinerators Incineration of hospital waste if carried out inappropriately could result into localized pollution of air with pollutants such as respirable ash, furans and dioxins.

7.3.4.1 Mitigation

- Adopt stack design based on best practice;
- Ensure operator of incineration unit is adequately trained for efficient operations.

7.3.4.2 Impact management

- Engineering design of stacks on onsite brick incinerators should follow good international industry practice
- Inspection/ monitoring: hospital administrators should undertake regular visual inspection of incinerator stack for incidents of downwash and undertake annual monitoring of air quality or a general environmental audit of entire healthcare facility;
- Training of incinerator operators is important for them to be familiar with key operational principles and efficient practices.

7.3.4.3 Impact mitigation

- Ensure proper waste management practices as recommended in the study on improvement of bio-medical waste management;
- Ensure proper management of pharmaceutical waste by engaging a Consultant to come up with measures and guidelines in accordance with the healthcare waste management plan;

7.3.5 Occupational health and safety risks

Medical facilities are a potential source of infectious waste in gaseous, liquid or solid forms. These could pose unsafe conditions for healthcare staff. Of particular concern are handling infectious waste (including sharps) without adequate protective gear, storage of sharps in containers that are not puncture-proof and management of radioactive waste at healthcare facilities where x-ray equipment will be installed. While some OHS risks will be new borne by equipment or services introduced after renovation or upgrade of facilities, most other effects are existing (hence cumulative) and would only be acerbated by increased scale of healthcare services.

7.3.5.1 Impact mitigation

The primary measure to mitigate OHS impacts is prevention which entails identification of risks and instituting pro-active measures to avoid them. For unavoidable risks, personal protective equipment (PPE) should be provided to workers. Places of work involving occupational exposure to ionizing radiation should be provided with requisite protection established and operated in accordance with recognized international safety standards and guidelines.

7.3.6 Fire Safety

Without provisions for fire safety, there is a risk of fire outbreak at healthcare facilities with disastrous life and financial impacts. Fires can start from ignitable materials in laboratories, cigarette smoking in non-designated places or old electrical connections.

7.3.6.1 Impact mitigation

- Provide fire extinguishers to healthcare facilities during their renovation;
- Key healthcare staff should have basic training in fire control;
- Fire emergency telephone numbers should be displaced in communal areas Impact management;
- Each healthcare facility should have a fire emergency management plan;
- Undertake fire drills at healthcare facility, at a minimum once a year.

7.3.7 Misuse or inability to use installed equipment

This project would be in vain if healthcare staff had no requisite training and skill to use installed equipment for improved service delivery. This would be a significant, negative medium-term but reversible impact.

7.3.7.1 Impact management

Through regular supervision, ensure only trained authorized personnel operate equipment.

7.3.8 Not maintaining improved facilities

When improved facilities are not continually maintained, they would quickly degenerate to pre-project condition. This would be a negative, significant medium-term impact of local spatial extent but reversible.

7.3.8.1 Impact management

Maintain a maintenance budget.

8.0 ANALYSIS OF PROJECT ALTERNATIVES

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

An alternative in relation to a proposed activity refers to the different means of meeting the general purpose and requirements of the activity, which may include alternatives on:

- Technology;
- Design;
- Incinerator; and,
- Site

8.1 Technology Alternatives

There were alternatives in terms of technology. There are three primary forms of treatment which can be used. These are categorized as being either:

- Thermal: Incineration, Autoclaving, Microwaving;
- Chemical: Chlorine disinfection
- Mechanical: Shredding, Grinding, Mixing and Compaction.

8.1.1 Thermal

Under thermal technology alternative, there are three difference alternatives which are:

- Incineration;
- Autoclaving; and,
- Microwaving.

Incineration

Small-scale incinerators are a useful technology to combust household medical waste. instead of discharging it in a dumpsite. It helps to avoid open burning of medical waste which creates much more harmful emissions and endanger human health and environment. Costs for these incinerators range from very high to low, but it is often possible to construct the incinerators by instructed community members and with local materials such as bricks and steel. The waste should be separated previously in order to retain organics or recyclable material before incineration. The ashes can contain toxic substances and heavy metals and should therefore, if possible, be disposed of safely. Trained labourers should operate such systems and always wear gloves and face masks to avoid injuries and health risks.

Autoclaving

Autoclaving is considered to be a low-heat thermal treatment, which uses steam, heat and pressure to disinfect waste. An autoclave consists of a metal chamber designed to withstand high temperatures and pressures, with a sealable door and series of pipe-work and valves that serve to introduce and remove steam to and from the vessel. Autoclaving is able to treat cultures and stocks, sharps, laboratory waste (excluding chemical waste) and infectious waste. Waste which cannot or should not be autoclaved includes chemical waste, volatile and semi-volatile organic compounds, chemotherapeutic waste, cytotoxic and pathological waste.

Although possible to treat pathological waste and other large bulky wastes such as bedding material and large animal carcasses, time and temperature parameters make this option unfeasible.

Microwaving

Microwave treatment is a steam based process that is undertaken with moist heat and steam generated by microwave energy. Water within the waste materials is rapidly heated and kills pathogens through heat and pressure. The type of wastes treated by microwaving is very similar to those treated by autoclaving. Microwaving is able to treat cultures and stocks, sharps, laboratory waste (excluding chemical waste) and non-anatomical infectious waste. Volatile and semi-volatile organic compounds, bulk chemotherapeutic wastes, mercury, and chemical wastes should not be treated in a microwave.

8.1.2 Chemical

Chemical Treatment involves the use of chemical disinfectants to destroy pathogens. The degree to which chemical treatment is successful in pathogen destruction is dependent on various factors such as: disinfection type, surface area of waste particle, temperature and pH. Chemical disinfection has been used for treating liquid waste, pathological waste (blood, urine) non-anatomical Infectious waste, and sharps. It is therefore unable to treat pharmaceutical, chemical or cytotoxic waste. Negative impacts associated with this treatment include potential toxic emissions and liquid contaminants.

8.1.3 Mechanical

Mechanical treatment is generally an additional treatment stage that is used in conjunction with either thermal or chemical treatment to reduce treated waste volumes.

Need and Motivation for Incineration

These alternative technologies were not further investigated, as Incineration is the only form of treatment that is able to treat selected medical waste. It is therefore the only feasible option for treatment of some forms of waste at the hospital

8.2 Design Alternatives

The small brick Incinerator is already specifically designed for incineration purposes. The design of the incinerator therefore cannot be altered. Design alternatives can be considered with regard to the type of filtration system used for air quality management. The proposed incinerator technology has proved to have far greater emission controls . Since air emissions are one of the primary negative impacts associated with incinerators, using the best form of air emission control system is a positive aspect for both public and environmental health. It is therefore the preferred system for management of atmospheric emissions for the proposed incinerator.

8.3 Incinerator type

Pyrolytic incinerator

Pyrolysis plants with after burning chambers are mainly used for smaller plants. These small plants usually operate in a discontinuous mode. For the purpose of bio-medical waste this is charged packed in barrels or bags. Larger plants should be equipped with automatic loading devices. At plants with degassing and/or gasification the processes drying, degassing and gasification take place in a reactor prior to combustion.

Waste is introduced discontinuously into a distillation chamber that is heated up to a sufficient temperature in order to distil the waste. Gases leaving the distillation chamber are mixed with a continuous airflow in the afterburning chamber and held at a temperature of about 900 °C by co-firing of natural gas. If the quantity of distilled gas is too high the volume of fired natural gas will be reduced automatically. Combustion gases leaving the afterburning chamber are cooled in a downstream hot water boiler and routed to a flue gas cleaning sys- tem. The boiler converts water into steam. The steam can be used to produce electricity to run a hospital, homes or businesses. The smouldering process is done periodically. In order to ensure a sufficient burnout of the ash it is fired with gas burners before it is discharged from the distillation chamber. At small plants fluctuations of the throughput and inhomogeneities of combusted waste are compensated by the auxiliary fuels.

As to pyrolysis plants the dust content of flue gases is small compared to conventional com-bustion systems. However, there is a great demand for additional fuels, so that consequently high volumes of flue gas are formed. Typical incinerator capacities (on-site treatment): 200 kg to 10 tonnes/day

Rotary kiln

Another technology used is the rotary kiln. The combustion of health-care waste can be performed in either small rotary kilns (e.g. in the hospital) or, more common, in larger plants used for the combustion of several hazardous waste fractions.

Wastes are delivered from the bunker into the waste chute which is located in front of the firing using a crane. In most cases a sluice is integrated into the chute where waste can directly be fed into the rotary kiln. Highly viscous and liquid wastes can be inserted through the front wall of the rotary kiln. As a result of the slope and the rotation of the rotary kiln, wastes are transported and circulated, which leads to intensive contact with primary air that flows through the rotary kiln. In contrast to grate firings rotary kilns are closed systems. Therefore also liquid and highly viscous materials can be inserted. Exhaust gases coming out of the rotary kiln are treated in an afterburning chamber. In order to assure high temperatures necessary for complete destruction of organic compounds (850 – 1200 °C depending on the waste) afterburning chambers are equipped with burners that automatically start when the temperature falls below the given value. At the end of the rotary kiln slag arises either sintered or melted. By dropping into the water of the deslagging unit, granulated slag is formed. When the slag is sintered then this part of the plant is similar to that of a grate firing system. Rotary kilns and afterburning chambers are in most cases constructed as adiabatic, ceramically lined combustion chambers. After the combustion chamber flue gases pass a void zone until a temperature range of about 700 °C is reached. Subsequently heating bundles such as evaporators, super-heaters and feed water pre-heaters are arranged. Waste heat boiler and energy supply system is comparable to that of grate firing systems.

Grate incinerator

Incineration of health-care waste in municipal waste incinerators requires special adaptations. If infectious health-care waste is to be burned in a municipal waste incinerator it has to be disinfected/sterilized beforehand or fed into the incinerator in appropriate containers by automatic loading. Previous mixing of infectious waste with other waste types and direct handling has to be avoided.

Fluidized bed incinerator

The fluidized bed incinerator is a lined combustion chamber in the form of a vertical cylinder. In the lower section, a bed of inert material (e.g. sand or ash) on a grate or distribution plate is fluidized with air. The waste for incineration is continuously fed into the fluidized sand bed from the top or side. Preheated air is introduced into the combustion chamber via openings in the bed-plate, forming a fluidized bed with the sand contained in the combustion chamber. The waste is fed to the reactor via a pump, a star feeder or a screw-tube conveyor. In the fluidized bed, drying, volatilisation, ignition, and combustion take place. The temperature in the free space above the bed (the freeboard) is generally between 850 and 950 °C. Above the fluidized bed material, the free board is designed to allow retention of the gases in a combustion zone. In the bed itself the temperature of is lower, and may be around 650 °C. Because of the well-mixed nature of the reactor, fluidized bed incineration systems generally have a uniform distribution of temperatures and oxygen, which results in stable operation. For heterogeneous wastes, fluidized bed combustion requires a preparatory process step for the waste so that it conforms to size specifications. For some waste this may be achieved by a combination of selective collection of wastes and/or pre-treatment e.g. shredding. Some types of fluidized beds (e.g. the rotating fluidized bed) can receive larger particle size wastes than others. Where this is the case the waste may only require only a rough size reduction or none at all.

All these types of incinerators could not suit the hospital especially due to space. This therefore leaves the small brick incinerator as the only viable alternative.

8.4 Site Alternatives

Initially, various locality alternatives were evaluated for the location of the Incinerator. Reasons for siting the project within the hospital was chosen.

9.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

9.1 Environmental Monitoring

Environmental monitoring provides feedback about the actual environmental impacts of a project. Monitoring results help judge the success of mitigation measures in protecting the environment. They are also used to ensure compliance with environmental standards, and to facilitate any needed project design or operational changes. An environmental monitoring program is important as it provides useful information and helps to:

- Assist in detecting the development of any unwanted environmental situation, and thus, provides opportunities for adopting appropriate control measures;
- Define the responsibilities of the project proponents, contractors and environmental monitors and provides means of effectively communicating environmental issues among them;
- Define monitoring mechanism and identify monitoring parameters;
- Evaluate the performance and effectiveness of mitigation measures proposed in the Environmental Management Plan (EMP) and suggest improvements in management plan, if required;
- Find out pollution level inside the plant and in nearby area;
- Compile pollution related data for remedial measures;
- Find out efficiency level of pollution control measures adopted.

Environmental monitoring program describes the processes and activities that need to take place to characterize and monitor the quality of the environment. Different activities involved in the proposed project and their impact on various environmental attributes have been taken into account while designing a detailed environmental monitoring program. Environmental monitoring program should be been prepared for the proposed project for assessing the efficiency of implementation of Environment Management Plan and to take corrective measures in case of any degradation in the surrounding environment. Results of monitoring will be reviewed, analyzed statistically and submitted to concerned authorities. Environmental Monitoring Program will include: (i) continuous online monitoring of the incinerator stack emission for flue gas parameters, (ii) incinerator stack emission monitoring to ensure compliance with emission standards, (iii) ambient air quality monitoring, (iv) analysis of treated wastewater, especially in case of discharge, (v) periodic monitoring of incineration ash and ETP sludge, (vi) other parameters as prescribed in Consent for Operation (CFO) etc

9.2 Environmental Management Plan (EMP)

Negative impacts						
Air pollution due to improperly designed incinerator stacks						
Impact and Mitigation/Enhancement commitments	**Desired Outcomes**	**Monitoring: Performance Indicators/Targets or Acceptance Criteria**	**Timing**	**Responsibility**	**Incremental Costs (Ksh)**	**Capacity Building and Training Requirements**
Incinerator stacks designed according to right guidelines	No offsite air pollution from incineration (such as due to plume downwash).	Visual observation reveal no plume downwash of stack emissions	From start of use of the incinerator	Facility administrator	Negligible	None
Train operator of incineration unit in efficient operations.	Incineration does not generate dioxins	Incinerator operator complete training course	1 month before commissioning incinerator	Management	10,000	Operation of incineration unit/ facility
Community health risk due to improper waste management						
Ensure proper waste management practices	No staff health risk due to improper waste management	medical waste is well managed	Daily	Facility administrator	Negligible	None
Occupational health and safety risks						
Provide PPE to all workers Places of work involving occupational exposure to ionizing radiation should be provided with	Minimal work-related injuries or infections	All healthcare staff have necessary PPE	Daily	Management	Negligible since all requisite PPE to be provided	Basic fire fighting skills (conducted by fire extinguisher supplier)

requisite protection established and operated in accordance with recognized international safety standards and guidelines.						
Fire risk						
Provide fire extinguishers near the incinerator. Key healthcare staff should have basic training in fire control. Fire emergency telephone numbers should be displaced in communal areas. Each healthcare facility should have a fire emergency management plan. Undertake fire drills at healthcare facility, at a minimum once a year.	Need for a basic capacity to fend off a small or average fire outbreak	Need to have a medium-size fire extinguishers (one of which should be for electrical fires) At least 2 medical staff have certificate of basic fire fighting. Fire emergency telephone numbers displaced in at least 2 communal areas. A documented fire emergency plan. A documented fire drill.	All the time	Management		Basic fire fighting skills Fire drill and emergency plan to be developed
Misuse or inability to use installed equipment						
Provide requisite training from the beginning	Medical equipment not misused and operated by trained staff	A staff assigned to operate and manage the incinerator	From the beginning	Managemnt	Negligible since the responsible person is a member of the staff	None

10.0 CONCLUSION AND RECOMMENDATION

10.1 Conclusion

The result of this EIA report has indicated that most of the potential negative impacts to be generated can only cause irreparable damage to the environment and human health if the mitigation measures are not implemented as recommended. The performed EIA showed all anticipated impacts (both positive and negative), associated with the project. Appropriate mitigation measures as explained in the environmental study shall reduce, if not eliminate, these impacts so that these are within acceptable limits. Moreover, no deterioration, depletion or exploitation of local natural resources is expected to be caused by this project. Based on overall assessment of the environmental impact of the project, it is concluded that the project is not likely to cause any significant adverse impact on the social, physical and biological environment of the area, provided that suitable mitigation measures as identified in this study are implemented

10.2 Recommendations

The Environmental Impact Assessment study results are finally evaluated to recommend the following:

- Implementation of EMP must be given top priority;
- Proper PPEs including ear plugs, ear muffs, mufflers, goggles, gloves and shoes etc. Should be provided to workers;
- Workers should be trained on how to use PPEs;
- Workers should be advised to follow standard Operating Procedures (SOPs;
- Installation of fire extinguishers in near incinerator premises and their monitoring must been sured;
- Small waste storage bins should be installed at different corner for proper waste collection and disposal;
- Proper dispensary and first aid box should be provided for workers;
- The Security Guards shall also be trained to act in case of all possible emergency situations;
- The fire alarms can be activated to signal evacuation. At the same time, communication shall be made with hospitals, emergency services and police for urgent support.

On the basis of the above it is our recommendation that the proposed project be licensed provided the EMP, is adhered to.

References

Government of Kenya: The Environmental Management and Co-ordination Act, 1999.

Government of Kenya: Environmental Management and Coordination Act. 1999.

Government of Kenya: Environmental Management and Coordination Act. 2015.

Government of Kenya: The Environmental (Assessment and Audit) Regulations, 2003.

Government of Kenya: The Land Planning Act.

Government of Kenya: The Occupational Safety and Health Act, 2007.

Government of Kenya: The Physical Planning Act, 1996.

Government of Kenya: The Public Health Act Cap 245.

Government of Kenya: The Water Act, 2002.

ANNEX ONE: COPY OF THE TITLE DEED

REPUBLIC OF KENYA

THE REGISTERED LAND ACT
(Chapter 300)

Title Deed

Title Number KWALE/DIANI COMPLEX/1

Approximate Area 0.40 Ha.

Registry Map Sheet No. 3

This is to certify that KAWALJEET SINGH REKHI

ID/NO.12488468/75 = = =

= = = = =

= = = = =

is (~~are~~) now registered as the absolute proprietor(~~s~~) of the land comprised in the above-mentioned title, subject to the entries in the register relating to the land and to such of the overriding interests set out in section 30 of the Registered Land Act as may for the time being subsist and affect the land.

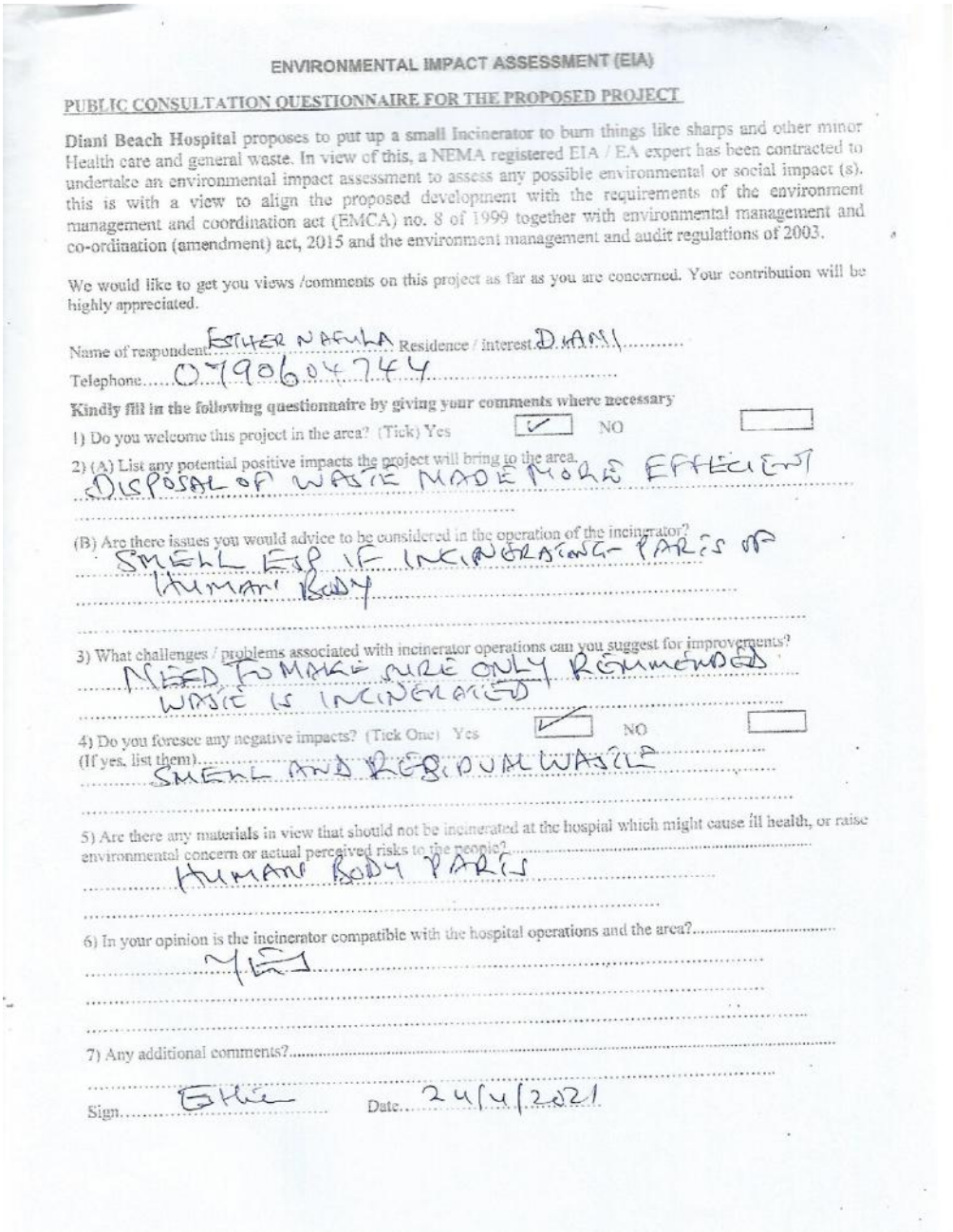
GIVEN under my hand and the seal of the

K W A L E District Land Registry

this 25th day of May, 1995

Land Registrar

ANNEX TWO: QUESTIONAIRES



ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent ESTHER NAFULA Residence / interest DIANI

Telephone 0790604744

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes [✓] NO [ ]

2) (A) List any potential positive impacts the project will bring to the area.
DISPOSAL OF WASTE MADE MORE EFFECIENT

(B) Are there issues you would advice to be considered in the operation of the incinerator?
SMELL ESP IF INCINERATING PARTS OF HUMAN BODY

3) What challenges / problems associated with incinerator operations can you suggest for improvements?
NEED TO MAKE SURE ONLY RECOMMENDED WASTE IS INCINERATED

4) Do you foresee any negative impacts? (Tick One) Yes [✓] NO [ ]
(If yes, list them) SMELL AND RESIDUAL WASTE

5) Are there any materials in view that should not be incinerated at the hospital which might cause ill health, or raise environmental concern or actual perceived risks to the people?
HUMAN BODY PARTS

6) In your opinion is the incinerator compatible with the hospital operations and the area?
YES

7) Any additional comments?

Sign. Esther Date. 24/4/2021

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent Mohamed Ali Residence / interest Patient / Community

Telephone.....

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes ☑ NO ☐

2) (A) List any potential positive impacts the project will bring to the area.

- Making the environment clean
- Better way of dealing with waste

(B) Are there issues you would advice to be considered in the operation of the incinerator?

Safety of Patients and Staff

3) What challenges / problems associated with incinerator operations can you suggest for improvements?

Operations need to be well organized

4) Do you foresee any negative impacts? (Tick One) Yes ☑ NO ☐

(If yes, list them) Fumes and waste from incineration

5) Are there any materials in view that should not be incinerated at the hospital which might cause ill health, or raise environmental concern or actual perceived risks to the people?

Foetus and parts of human body can cause small

6) In your opinion is the incinerator compatible with the hospital operations and the area?

Yes

7) Any additional comments?

Sign ..... Date 25/4/2021

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent... Seif Mwajoa. Residence / interest... Ukunda

Telephone... —

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes [✓] NO [ ]

2) (A) List any potential positive impacts the project will bring to the area.

Sharps will be well dealt with.

(B) Are there issues you would advice to be considered in the operation of the incinerator?

Smoke can be an issue

3) What challenges / problems associated with incinerator operations can you suggest for improvements?

Smoke / smell / injuries

4) Do you foresee any negative impacts? (Tick One) Yes [✓] NO [ ]
(If yes, list them)...

Smoke

5) Are there any materials in view that should not be incinerated at the hospital which might cause ill health, or raise environmental concern or actual perceived risks to the people?...

Not incinerate human bodies

6) In your opinion is the incinerator compatible with the hospital operations and the area?...

Yes

7) Any additional comments?...

Sign... Date... 20/4/2024

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent. SHADRACK Residence / interest... DIANI UKUNDA

Telephone..... 0790 631896

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes [✓] NO [ ]

2) (A) List any potential positive impacts the project will bring to the area.

CLEAN INVERONMENT

(B) Are there issues you would advice to be considered in the operation of the incinerator?

ALLOCATED AWAY FROM THE REACH OF CHILDRENS

3) What challenges / problems associated with incinerator operations can you suggest for improvements?

EXPLOSIVE EMPTIES

4) Do you foresee any negative impacts? (Tick One) Yes [ ] NO [✓]
(If yes, list them).....

5) Are there any materials in view that should not be incinerated at the hospital which might cause ill health, or raise environmental concern or actual perceived risks to the people?.....

EXPLOSIVE EMPTIES

6) In your opinion is the incinerator compatible with the hospital operations and the area?.....

Yes

7) Any additional comments?.....

Sign..... Date..... 24/5/21

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent..FAITH MUENDE.... Residence / interest.....UKUNDA.....

Telephone.....0725545495.....

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes [✓] NO [ ]

2) (A) List any potential positive impacts the project will bring to the area.

(1) Pollution control

(2) Hygenic benefits

(B) Are there issues you would advice to be considered in the operation of the incinerator?

Smoke control

3) What challenges / problems associated with incinerator operations can you suggest for improvements?

- Ensuring that smoke is well controlled so it doesn't affect people around it

4) Do you foresee any negative impacts? (Tick One) Yes [ ] NO [✓]

(If yes, list them).....

Smoke - if not well controlled

5) Are there any materials in view that should not be incinerated at the hospial which might cause ill health, or raise environmental concern or actual perceived risks to the people?.....

—

6) In your opinion is the incinerator compatible with the hospital operations and the area?.....

Yes

7) Any additional comments?.....

Sign.....FM..... Date.....21/05/2021.....

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent..BERYL OPIYO.. Residence / interest..DIANI BEACH ROAD..
Telephone..0703965277.....

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes [✓] NO [ ]

2) (A) List any potential positive impacts the project will bring to the area.
It will help in waste reduction in the area

(B) Are there issues you would advice to be considered in the operation of the incinerator?
To ensure the incinerator doesn't cause any environmental pollution

3) What challenges / problems associated with incinerator operations can you suggest for improvements?
to ensure sharp objects are well disposed

4) Do you foresee any negative impacts? (Tick One) Yes [ ] NO [✓]
(If yes, list them).....

5) Are there any materials in view that should not be incinerated at the hospial which might cause ill health, or raise environmental concern or actual perceived risks to the people?.....
None

6) In your opinion is the incinerator compatible with the hospital operations and the area?.....
Yes. It is compatible.

7) Any additional comments?.....N/A.....

Sign.....Date..11/5/2021.....

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent... Monica Kamau Residence / interest.... CORNER MUSA

Telephone..... 0723 809043.....

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes [✓] NO [ ]

2) (A) List any potential positive impacts the project will bring to the area.

..... Control of waste management .....

(B) Are there issues you would advice to be considered in the operation of the incinerator?

..... SO far it is Okay .....

3) What challenges / problems associated with incinerator operations can you suggest for improvements?

..... To ensure no accident or incident .....
..... that occur .....

4) Do you foresee any negative impacts? (Tick One) Yes [ ] NO [✓]
(If yes, list them).....

5) Are there any materials in view that should not be incinerated at the hospial which might cause ill health, or raise environmental concern or actual perceived risks to the people?.....

..... NONE .....

6) In your opinion is the incinerator compatible with the hospital operations and the area?.....

..... YES .....

7) Any additional comments?..... NO .....

Sign..... Date.... 10/5/2021 .....

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PUBLIC CONSULTATION QUESTIONNAIRE FOR THE PROPOSED PROJECT

Diani Beach Hospital proposes to put up a small Incinerator to burn things like sharps and other minor Health care and general waste. In view of this, a NEMA registered EIA / EA expert has been contracted to undertake an environmental impact assessment to assess any possible environmental or social impact (s). this is with a view to align the proposed development with the requirements of the environment management and coordination act (EMCA) no. 8 of 1999 together with environmental management and co-ordination (amendment) act, 2015 and the environment management and audit regulations of 2003.

We would like to get you views /comments on this project as far as you are concerned. Your contribution will be highly appreciated.

Name of respondent... Abigael okelo Residence / interest... Kombani

Telephone... 0706873152

Kindly fill in the following questionnaire by giving your comments where necessary

1) Do you welcome this project in the area? (Tick) Yes [✓] NO [ ]

2) (A) List any potential positive impacts the project will bring to the area.

...—...

...—...

(B) Are there issues you would advice to be considered in the operation of the incinerator?

...

...

...

3) What challenges / problems associated with incinerator operations can you suggest for improvements?

...NON...

...

4) Do you foresee any negative impacts? (Tick One) Yes [ ] NO [✓]
(If yes, list them)...

...

...

5) Are there any materials in view that should not be incinerated at the hospital which might cause ill health, or raise environmental concern or actual perceived risks to the people?...

...NO IDEA...

...

6) In your opinion is the incinerator compatible with the hospital operations and the area?...

...

...—...

...

7) Any additional comments?...

...—...

Sign... ...Date... 24/9/2021...