ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY REPORT FOR THE INTERGARATED SOLID WASTE MANAGEMENT FACILITY IN KERARAPON, NGONG, KAJIADO COUNTY - KENYA

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NOVEMBER, 2018

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Disclaimer:

This Environment and Social Impact Assessment study Report is based on the information made available by the client to the consultants and findings from field assessments. The information contained in this report is accurate and a truthful representation of all findings relating to the proposed project.

Table 1 List of planning and participating consultants

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ACRONYMS

BOD	Biological Oxygen Demand
CBOs	Community Based Organisations
COD	Chemical Oxygen Demand
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
EMP	Environmental Monitoring Plan
ESIA	Environmental and Social Impact Assessment
IWMF	Integrated Waste Management Facility
KFS	Kenya Forest Service
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organisations
PAP	Project Affected Persons
PSP	Private Service Providers
SDGs	Sustainable Development Goal s
SIA	Social Impact Assessment
WB	World Bank
WRMA	Water Resources Management Authority

EXECUTVE SUMMARY

Introduction

One of the main challenges currently facing the county governments in Kenya is solid waste management. The county governments and other stakeholders who are mandated to ensure a sustainable solid waste management system in their respective counties have an uphill task as the uncollected garbage litter streets and dumping sites overflow with solid waste. The poor management of solid waste has posed severe social, economic and environmental challenges as well as impacts, especially in cities and other urban areas due to rapid urbanisation and high population growth rate in such areas (NEMA, 2014).

This Environmental and Social Impact Assessment (ESIA) for the commissioning of an Integrated Waste Management Facility (IWMF) at Kerarapon Vet Farm was carried out as per the Terms of Reference (ToR) provided by the contract involving UN-Habitat, Politecnico di Milano, Technical University of Kenya and National Environment Management Authority (NEMA). This was conducted in accordance to the Environmental Impact Assessment and Audit Regulations, 2003; as amended in 2015. To adequately address the environmental issues emanating from the implementation of the proposed project, a team of experts carried out environmental and social screening for the project. This comprised of the mobilization, liaison and stakeholders consultations, a scoping exercise, desktop and field studies, data analysis, impact assessment, and analysis of health and safety issues associated with the proposed project. Secondary data was collected from review of books, journals, newspapers, magazines, previous studies (theses) on solid waste management, papers and reports, policies, regulations, development plans, laws and by-laws on solid waste management. Primary data was collected through observation of activities at the site, photographs taken, samples collected, interviews of heads/spouses of households and officers in institutions done and questionnaires administered within one kilometre radius from the proposed facility.

Location

The County Government has identified an area located in Kerarapon sub location (Embulbul) known as “Vet Farm” to host the proposed solid waste treatment plant. The total surface area of the available space is around 140,000 m^2.

At present, the area is accessible only through a road that traverses the surrounding forest. During interviews carried out in the social assessment, several concerns were raised by stakeholders:

Possible environmental issues are mainly related to the existence of water springs in the area, which could be contaminated in case of lack of respect for safeguard buffers, or even depleted by excavations, as apparently has happened with other construction works such as the Standard Gauge Railway (S.G.R.). Other issues are related to the potential degradation of Embakasi (Kibiku) forest.

Conflicts on land property and land use: according to interviews and articles on newspapers, a dispute between Kajiado North and Kajiado West Constituencies is ongoing with reference to that area, which is probably subjected as well to phenomenon of 'land grabbing'. The County Government affirms that the land in question is public, so the dispute appears to be connected with its final use.

New sites were proposed by the association of residents of Kerarapon (KEREA), which was interested in maintaining the value of its property (that would probably be decreased in the presence of a new waste treatment facility). Those sites were Oloshoibo and Kimoka. Another site (the quarry located in Embulbul) was also taken into consideration during the field visit by the team of experts. This site was favoured by some stakeholders while at the same time opposed by others. A public act which forbids the use of the site for waste management was mentioned during the consultative meeting with the community, but unfortunately authentic copy of such document was never adduced.

The identified area located in Kerarapon sub location (Embulbul) known as "Vet Farm" remains the most preferable by all means considered. In this sense, an analysis carried out by the advisory team identified some potential weaknesses of the area for the scope of hosting a new waste treatment facility, mainly because of the following:

- it is an uncontaminated green area (pristine environment);
- it is bordering the Kibiku forest;
- It is very close to a residential settlement (less than 250m);
- it lacks an acceptable access road.

However, the above mentioned issues were analyzed and discussed in detail with UN-Habitat and the following facts were also highlighted:

- part of Kibiku forest was planted with eucalyptus through an afforestation program and could not be used as an obstacle to the project from the environmental point of view;
- there is already a planned road access to the area to avoid interference with the forest;
- the selection of this site was the result of a long and complex decision-making process during which several alternatives were assessed;
- the identification of an alternative site together with all the administrative works will take years and may delay significantly the implementation of the project;
- the County of Kajiado also requested that the type of technology to be implemented at the site should have minimum impacts to the surrounding environment.

In conclusion, considering such sentiments and the high social and environmental impact represented by the existing illegal dumpsite and the emergency situation that the pollution is causing with serious negative effects on the population, the use of the site currently selected appears to be the most reasonable solution.

The Project

This project involves the commissioning of the Kerarapon waste management facility as stipulated by Kajiado County. The Government of Kenya and the County Government of Kajiado have identified solid waste disposal for Kajiado County as a priority problem and has requested the Italian Government for assistance in financing the construction of a new sanitary landfill (ISWM), under the proposed Integrated Waste Management Plan. The new sanitary landfill ISWM system proposed to be constructed through GOK financing in collaboration with the Italian government will include leachate collection, resource recovery, electricity generation and landfill gas collection but not limited to management systems as needed to result in environmentally acceptable pollution control. The proposed project will include operational equipment to spread, grade and cover solid wastes received by the landfill in a cost-effective manner. The new sanitary landfill would allow for cessation of solid waste disposal operations at the existing disposal site at Ngong' dumpsite.

Therefore, before construction of a new sanitary landfill/Integrated Solid Waste Management System and commissioning of the new facility, an environmental and social impact assessment study was a requirement. This was to provide inputs to the final design (as part of

an interactive process of design and environmental/public assessment which is required by Environmental Management and Coordination Act (Cap 387) in order to obtain an optimally environmentally acceptable and cost-effective design). The final design was to incorporate mitigation measures to address potential adverse impacts and significant public concerns. Mitigation measures within the final design include construction details, operations and management plans for the new waste management system and commissioning of the disposal site.

Kerarapon ISWM may present major positive and negative environmental impacts to the local environment. Lack of clear understanding of the new facility is a major challenge with the local residents and authority. The identified site is flanked by Kibiku forest, the Vet farm and modern housing. Land use conflicts with regards to the surrounding may cause a challenge. Its main impacts on the entire surrounding environment include: air, soil, noise and water pollution, health risks to wildlife and human population. Increase of traffic to the area will affect animal habits and interrupt the serenity of the area for the residents. This may encourage increased human traffic for those engaged in the facility. Security will become an issue with increased human traffic and encroachment by human informal settlement shall be encouraged.

Justification of the project

The project involves implementation of the recommendations of the Kajiado County on solid waste management plan in accordance with the provisions of the constitution of Kenya 2010 for access to a healthy environment to every human being, which has been considered a basic human right. The eighth Sustainable development Goal emphasises the provision of safe clean water and safe environment. Further vision 2030 social pillar targets the implementation of an integrated solid waste Management system which the project seeks to achieve.

According to the Kajiado plan on sustainable environmental management, there is need to rehabilitate, restore and manage Ngong' River Ecosystem in order to provide for improved livelihoods and enhanced biodiversity and sustainable supply of water for domestic, industrial and recreation purposes. Therefore decommissioning of Ngong' dumpsite and commissioning of Kerarapon facility will contribute to the achievement of these policy directions and strategic actions. The TWTF will mainly be composed of the following elements:

- a sorting facility;

- a processing plant (plastic shredder machine);
- a sanitary landfill including biogas collection system;
- a service building (toilets, showers etc);
- a storage for sorted recyclable materials.

In particular, the sanitary landfill will be constructed based on the requirements of the international standards for this kind of facilities, which will ensure a base lining and a leachate collection and recirculation system. The height of the waste disposed in the TWTF will be 5-6 m in order to avoid extensive excavations and extensive lining works and ensure a transitional period around 18-24 months (depending on the compaction of the incoming waste) for the commencement of operation of the new facility. It is estimated that an area of approximately 15,000 m^2 with circumferential embankments 1.5 m high will adequate for the establishment of the sanitary landfill inside the TWTF.

Objectives of the Environmental and Social Impact Assessment (ESIA)

The main objectives of the ESIA is to ensure that all environmental consequences due to the Vet Farm area in its current state are evaluated and analyzed to warrant developing and operating a new Integrated Waste Management system for the county government of Kajiado. The environmental and socio-economic impacts evaluated and addressed as part of the mitigation measures incorporated into the facilities' final design.

Specific Objectives of the ESIA included the following

- To describe the site and its environmental status.
- To assess the socio-economic status of those who will be directly and indirectly affected by the facility.
- To collect baseline information of the project area with regards to climate, water, soils, roads, population, social economic factors and biological environment (fauna and flora)
- To review relevant legislations for such projects
- To collect views of the affected public and other stakeholders with regard to the presence of the facility.
- To determine land use conflicts that may result between the facility and its neighbourhood land uses,

- To determine the potential significant impacts of the project
- To propose alternatives to the project and/or project location
- To propose mitigation measures for the significant negative impacts
- To develop an EMP for the project

An outline of the methodology

The nature of commissioning of an Integrated Solid Waste Management facility calls for a full ESIA study to ensure public support, completeness and comprehensiveness of the report. During the assessment, the following steps were followed:

- Environmental screening that identified the project as among those requiring EIA under schedule 2 of EMCA amendment ,2015,
- Environmental scoping to provide the key environmental issues
- Desktop studies for background information
- Public participation with stakeholders using interviews,
- Public participation with questionnaires and focus group discussions
- Topographical surveys
- Geotechnical surveys
- Water, soils and air quality analysis

Project cost

Total cost of decommissioning Ngong dumpsite and commissioning the ISWM facility is approximately Kshs.2.3.billion.

The assessors sought views from the key stakeholders of the project. These included the project affected persons, communities living around the Kerarapon area, Water Resources Management Authority, Private Service Providers (PSPs), companies or organized groups such as Kerarapon Residents Association (KEREA) Waste Managers, waste pickers (scavengers), Oloolua Residents/local communities, Kajiado County, NEMA, Ministry of Environment and Forestry, Kenya Forest Service, Recyclers, Politicians/opinion leaders, Veterinary farmers, Religious leaders, Kerarapon water and Sewerage company.

Environmental and Social Impact Assessment (ESIA)

The expected impacts from this project are diverse in nature and will comprise of both long term and short term impacts. The short term impacts will occur during the construction of the facility and long term impacts will occur after the completion of integrated waste management facility that will contribute to improved health and provide a more pleasant environment for business and trade.

The project will mainly have positive impacts while mitigation measures will be proposed and designed for the anticipated negative impacts.

The positive impacts are both short term and long term and include the following:

Long term positive Impacts

i. Creation of job opportunities in the facility

ii. Improved health of the population living at the Ngong dumpsite through reduced cases of respiratory and water borne diseases

iii. Improved water quality in Ngong' river and other surface streams

iv. Improved solid waste management for Ngong' town and its environs

v. Improved aesthetic value of Ngong' area

vi. Reduced pollution to downstream ecosystems

vii. Reduced health hazards to downstream communities in Athi catchment

viii. Demonstration (model process) for commissioning of similar sites in other counties in the country

ix. Creation of job opportunities during implementation and operational phases

x. Improved physical infrastructure in the project area

xi. Improved security for Ngong' town

xii. Reduced pollution on the cultivation of food crops in the riverine area irrigated with effluent from Ngong' dumpsite

xiii. Creation of conducive living and learning environment and habitation of neighbouring schools, churches and communities

xiv. Reduced scavengers in Ngong' town

Short- term positive Impacts

i. Expand opportunities for small scale businesses in the area

ii. Creation of job opportunities during construction and implementation phases

The negative impacts are both short and long term

Long term Negative Impacts

i. Loss of dumpsite linked livelihood

ii. Emission of gases

iii. Contamination of surface and ground water by leachates

iv. Disruption of social networks

Short term Negative Impacts

i. Disruption of socio economic activities in the project area

ii. Destabilisation of bird community at the site

iii. Influx of heavy trucks and machinery in the area disrupting traffic flow

iv. Loss of vegetation established in the area

v. Soil erosion in exposed and destabilized slopes

vi. Atmospheric pollution by dust particles and greenhouse gases

vii. Elevated noise and vibrations in the project environment

viii. Temporary influx of people in the area from outside environs

Conclusion and Recommendations

The main negative impacts of the implementation of an Integrated Solid Waste Management facility is loss of vegetation as the area will have to be cleared and excavated for construction, soil erosion, atmospheric pollution by dust and smoke emissions from construction machines, disruption of social networks in the area, influx of heavy trucks and machinery in the area increasing noise and vibrations. Increased population along with issues

associated with population growth in an area such as constrained resources and competition for social amenities.

The main positive impacts of the facility include improved solid waste management in the county, creation of job opportunities, improved road infrastructure and the project will serve as a model for development of integrated waste management/ sanitary landfill in other counties. Many environmental impacts identified during the construction period are of short term and can be mitigated. Therefore supervision of the project implementation should be of high standard to ensure negative impacts are minimized, reduced and avoided. Positive impacts have long term positive influence on the development of the area and on the welfare of the people as a whole. The project is expected to promote a clean and healthy environment in the area, promote the economy, and enhance social economic standards of the population in the area and beyond.

CHAPTER ONE
INTRODUCTION

1.1 Background and Rationale for an Environmental and Social Impact Assessment

The Italian Agency for Development Cooperation in conjunction with the ministry of Environment of Kajiado County through UN-Habitat supported the construction of an Integrated Solid Waste Management facility at Kerarapon area of Kajiado County. The new facility will recycle waste and generate energy for sale to the grid, as well as improving environmental sanitation, providing an affordable and fully-functional waste management system, raising awareness and community participation in waste segregation and collection and creating new employment opportunities (UN -Habitat, 2017)

The facility shall be located within the Vet Farm whose area is estimated at twenty acres. Solid Waste Management (SWM) is one of the key devolved functions that are handled within the docket of the Ministry of Environmental Management in the County Government of Kajiado. Therefore **UN**-Habitat is working with the Politecnico di Milano, Italy to carry out a feasibility study for closing Ngong' Town dumpsite and replacing it with a modern integrated municipal waste-to-energy plant. TU-K was therefore mandated by Politecnico di Milano to carry out an Environmental and Social Impact Assessment to enable decisions on the facility.

Kajiado County Government proposed the decommissioning of Ngong' dumpsite and commissioning of an Integrated Waste Management System at Kerarapon. The decommissioning of the dumpsite is necessitated by a myriad of environmental and socio-economic challenges associated with the dumpsite. Ngong' dumpsite is situated in Ngong' town, Kajiado North sub county, Kajiado County (TUK ESIA Ngong Decommissioning Report, 2018).

Kajiado is one of the largest administrative, commercial and administrative counties in Kenya (Figure 1). It has been experiencing rapid urbanization largely due to its geographic proximity to the capital city. The current population in Kajiado is estimated to be 687,312 people covering an area of 21,292.7 Km^2 projecting from the latest census of 2009. Kajiado North Sub County has a population of about 136,188 with the urban population of Ngong' town estimated at 20,657. According to the JIKA report 2010, the solid waste catchment of Ngong' town covers Kiserian and Ongata Rongai towns and generates about 40 tons of waste per day. The study conducted by TU-K established that the amount of waste is well over 100 tonnes (TU-K, 2018). Ngong' town, just like the larger Kajiado County has over the years experienced major challenges in managing solid waste. These include: Inappropriate and inadequate waste collection and transportation, poor access and inadequate infrastructure, funding limitations and constrained budget for Solid Waste Management (SWM) or illegal dumping which is a public health concern and is detrimental to the environment (JIKA, 2010).

It has been observed that half of the present solid waste generated is left uncollected or illegally dumped within the county and the remaining is carried to Ngong' disposal site .The disposal site, however, is an open dumping type landfill and this, therefore, has a detrimental effect on the surrounding environment. The major players in waste collection and transportation in this area include Private Service Providers (PSPs) and Community Based

Organizations (CBOs) which are more involved in SWM but in an unstructured manner. A dumpsite can be described as a landfill for solid waste disposal. This is the oldest and most organized form of handling waste around the world. In most scenarios such disposal; sites are usually located at the outskirts of urban areas and are the primary sources of contamination and act as incubation sites to most disease vectors that have negative impact on human populations (NEMA, 2014). Therefore the county found it necessary to establish an integrated Solid Waste Management Facility to take care of the waste generated in the county and beyond in a bid to rid Ngong' town of the menace of an open dumpsite. The county government selected the Vet Farm site as the most suitable location as it is owned by the county.

1.2 Description of the site

The Veterinary Farm, site proposed for the facility, is situated in Kerarapon Sub-Location, Ngong Division, Kajiado District about 25km from Nairobi City. The proposed site is twenty acres. A central challenge facing the area has been the availability of water, which is supplied to the residents twice a week. Water demand for an urbanizing population increases the stress on the limited water resources, and exacerbates competition between the sectoral users of Kibiku, Veterinary Farm and Kerarapon residents. The competing demands from the water schemes have resulted in conflicts such as between the Olopolos and Maasai pastoral communities who rely on the same water source for their livelihoods. Kibiku forest is the source of some of the streams (see fig 1)

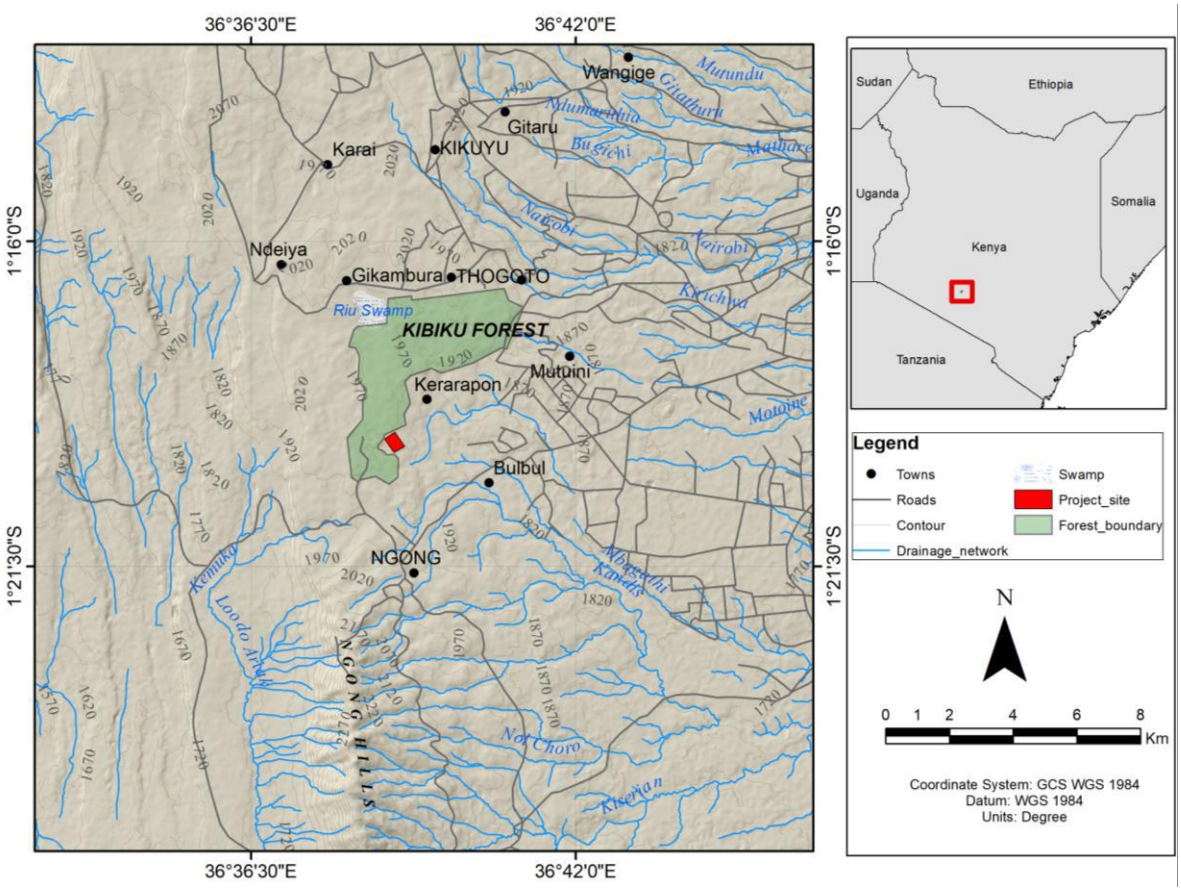

Figure 1 Map of the study area Ngong, Kerarapon, Kibiku forest

The water is not treated and is taken directly from the Gakong/Gatwe Springs. The water demand at Kerarapon is greater than the water supply from the catchment area, which has been worsened by the inefficient water uses. Moreover, there is a general lack of water management practices which has led to increasing water losses. The catchment area should therefore be protected from environmental degradation such as poor land management, bad agricultural practices and poor solid waste management as this will have serious negative implications on the water sources. It is therefore important to ascertain the extent to which the proposed waste facility will affect the environment. It is of paramount importance to seek advice from relevant water stakeholders. The absence of environmentally sustainable water resources management policies and the existing inadequacy of water from the springs must be rectified by exploring alternative options to improve the water availability.

The soil tests conducted have indicated that the existing soil type within the catchment area has a good soil water intake. Artificial water recharge methods can be used to increase groundwater resources in the catchment area. Similarly, addressing the water quality in the area should be strongly emphasized, in order to improve the present water treatment processes (Macharia, 2010).

1.3 Historical background of the Veterinary Farm (Vet Farm)

The allocation of land for a waste management facility began in 2007, and in 2010, twenty acres of land from Ngong Veterinary farm was earmarked for purposes of developing a dumpsite. It was approved by the permanent secretary to the cabinet and head of public service and the following Government Ministries were informed; Local government, State for provincial administration, Lands and Livestock development (Appendix 7).

According to the County - Government, the piece of land at the vet farm was selected because of its closeness to the Ngong' dumpsite and the fact that it was government land. Further the county government informed the assessors that NEMA was interested previously on the development however no scientific surveys were done for the site. Thus TUK provides the scientific survey results in this document.

As informed by the Kibiku residents, water has reduced tremendously in the new site because of the tunnel recently constructed for the Standard Gauge Railway (SGR). This is a serious environmental impact as previous reports indicate that the area is water scarce and therefore development that can worsen the situation need to be thought of carefully (Macharia, 2010). It was indicated that a 50 m buffer zone was considered and this therefore should take care of the biodiversity of the area. It was further stated that there is no other area in the county that is appropriate for the facility. Therefore, both the Central and County governments are already decided on this particular site. A suggestion given for the change of site to the current SGR quarry in the area has not borne fruit as apparently this may present other issues that are beyond the mandate of this study. The issues mentioned will include but not limited to the process of identifying and acquiring land. This is a lengthy exercise and may derail the whole project.

1.4 Description of the new Plant at Vet farm

There were a number of technological options available for an ISWM such as Thermo-chemical technologies, sanitary landfill etc, however for this project bio drying with landfill bioreactor technologies were found to be the most appropriate. The following section is a description of this technology**.**

Plate 1 ISWM Plant - Bioreactor and a biogas treatment and energy recovery system

Bio-drying technology

The new IWMF will have numerous salient features. As already introduced, bio-drying is particularly suited for waste with high moisture content, since it allows a partial evaporation of water by using the heat released by the aerobic biological degradation of the organic component. The only technological interventions required for the process are a preliminary light shredding (aimed at opening the bags in which waste is contained) and the forced air intake, by means of simple air blowers, for a duration that can range between 10 and 20 days. Then this process can be simply operated also by not-specialized staff, it has to be automatized as far as possible, with the staff only required to overlook the activity based on a simple and intuitive interface and few parameters to control. Bio-drying results in a relevant reduction of weight and moisture of the MSW entering the process (in the range 25-35%). The exhaust air needs to be treated before release in the atmosphere. This can take place by means of a bio-filter, which can be located on the roof or on the side of the bio-drying building. In this specific application, since the roof will be used to install the PV systems, the bio-filter may be placed on the ground, close to the bio-drying building. Plate 2 presents the described application of the bio-filter.

By reducing the putrescibility and humidity of waste, the following sorting operations aimed at recovering potentially recyclable materials (plastic, glass, metals) will be facilitated and

can be carried out with simple mechanical devices (sieves, magnets) or even by hand sorting, thus enhancing the role of the existing informal sector. The last option appears particularly suitable for the analyzed context for the re-integration of persons currently 'employed' in the illegal landfill. After the sorting, residual waste can be finally disposed in the engineered bioreactor for biogas production, or used as a refuse-derived fuel (RDF) in industrial thermal processes (e.g. cement production), according to its chemical and physical properties.

Plate 2 Bio-drying building and the coupled bio-filter on the roof

The bioreactor will take the place of the most common engineered landfill, receiving residues from previous stages. It has to be properly designed in order to avoid groundwater and soil contamination, it requires a drainage system for the leachate (the liquid part leaching from the waste) and a collection system for the biogas produced by anaerobic processes. State-of-the-art technologies for achieving such purposes are those complying with current European Union legislation on landfilling (Directive 1999/31). As leachate and biogas production are mainly influenced by the presence of the organic fraction, bio-drying can positively affect both these aspects by achieving a partial degradation of the organic fraction.

The new bioreactor will need to accommodate an annual range of 17,000 – 37,000 tons of bio-dried material. By considering a typical level of compaction and adding the daily coverage material, the total volume in a 20 years' time-span is in the range 550,000 – 850,000 m^3. Such volume might change (hopefully decreasing) in case some new waste management strategies will be put in place, namely the introduction of source separation of food waste. The area of the bioreactor will be less than 60,000 m^2. Generation of biogas will

start after 1-2 years, since a minimum amount of waste is needed before enhancing its generation by means of leachate recirculation. The amount of biogas produced will be burned in a co-generator unit producing heat and power (see section 6.4 for the estimation of the generated biogas). Such thermal energy will be enough to power the bio-drying and a considerable fraction of the electricity can be fed to the grid, ensuring the economic self-sustainability of the entire system.

The exploitation of renewable energy sources, with particular reference to solar energy by means of photovoltaic technology, is considered in the new facility in order to generate electricity to cover the energy demand while the biogas production starts and to minimize running costs during the entire system's lifetime. In detail, all the roofs of the designed buildings will be covered with a PV system, for a total estimated power around 800 kWp. Such PV plant is expected to generate approximately 1,300,000 kWh/year of electricity.

1.4 The Access Roads

The site in the Vet Farm has no roads currently. The road through the forest is impassable during the rainy season. However the project proposes a new road that shall be properly equipped and not interfere much with the area's biodiversity.

1.5 Land Use Planning and Management

Land use planning and management in Kenya is of great concern as poor planning has resulted in environmental, social and economic issues. The absence of a clearly defined land use policy in Kenya after years of independence has resulted in a haphazard approach to managing the different land use practices and policy responses (GoK, 2016). In Kajiado County land use activities, just like, the rest of the country is in conflict. In addition, land use issues continue to be addressed through many uncoordinated legal and policy frameworks that have done little to unravel the many issues that affect land use management. The Vet farm is bordered by Kibiku forest and Kerarapon residential area, this will definitely pose a land use conflict in terms of biodiversity conservation and the neighbouring residents may have issues with such a development.

CHAPTER TWO
ESIA APPROACH AND METHODOLOGY

2.1 Introduction

The EIA study was conducted in accordance with the requirements of the Environmental (Impact Assessment and Audit) Regulations, 2003; and Environmental (Impact Assessment and Audit) Regulations, (amendment), 2015. The Terms of Reference for the work is attached as Annex 5.

To adequately address the environmental issues emanating from the implementation of the proposed project, the team of experts carried out environmental and social Impact study. The environmental assessment was conducted by the experts in the field by doing soil analysis, water quality assessment and air quality determinations. The social assessment comprised of the field surveys with questionnaires, interviews and focused group discussions. Also stakeholders' consultations and analysis of health and safety issues associated with the project were conducted.

2.2 Screening exercise

From the screening process, it was determined that the project could be categorised under category A according to the world bank guidelines that negative impacts can be mitigated. A project is categorised as category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse and unprecedented, these impacts may affect an area broader than the site or facilities subjected to any activity. The Environmental Assessment for category A projects examines the projects potential negative and positive environmental impacts compares them with those of feasible alternatives and recommends any measures needed to minimize, mitigate or compensate for adverse impacts and improve environmental performance.

Consequently, it became necessary that an Environmental assessment through an environmental and social impact study as a tool would help in identifying, analyzing and developing practical mitigation measures for identified negative impacts. The screening exercise was conducted in line with the guidelines by National Environmental and Management authority-Kenya. 2003.

2.3 Secondary Data

Document analysis approach was employed to obtain relevant information on the political, social, economic and biophysical characteristics of the project area and its environs. Some of the documents reviewed include:

(a) Environmental Management and coordination Act, 1999

(b) Environmental Impact Assessment and Audit Regulation, 2003

(c) Population census report of, 2009

(d) World bank policy on environmental assessment OP.4.02

2.4 Primary Data

The primary data collection involved household survey, resource analysis, consultation with relevant experts and authorities.

2.4.1 House hold Survey

House hold surveys were conducted between 30th April and 24th May, 2018. The sample selected for the household survey was defined by the households and businesses directly affected by the proposed project. The targeted respondents consisted of people likely to be affected by the project either directly or indirectly. The total number of households interviewed/questionnaire living around the site was 43 households.

2.4.2 Social Impact Assessment

The information gathered during the desktop and field studies was used to build up the baseline information of the site. On the basis of acquired information, informed judgement and experiences from similar ongoing projects within Ngong', environmental and social impacts likely to emanate from the implementation of the project were made. Ultimately, the nature, magnitude and duration of both positive and negative environmental impacts were assessed and mitigation measures developed accordingly. Social Assessment was conducted using household survey, organizing stakeholder workshops, holding Key information interviews, using Observation and surveys and administering questionnaire schedules and Stakeholder consultation/public participation which focused on conforming to the current environmental legislations which emphasizes on comprehensive stakeholder consultations, consultations were held with key stakeholders including individuals, CBOs,NGOs, Private

sector institutions, government ministries and parastatals. The aim of consultation was to introduce the project, and have reservations and views integrated in the study.

2.4.3 Field Experiments and Laboratory Analysis

This exercised focussed on Water quality analysis, soil sample testing, air quality determinations and flora and fauna studies within the project site.

2.4.3.1 Soil sampling

Soil samples for analysis in the laboratory were collected on 4th, 5th and 19th April, 2018. Samples were collected from eight sites using randomised transects (see figure below). The sampling was well distributed over the entire field designated for the facility. Soil samples were analysed for texture, composition, Electrical Conductivity (EC) and heavy metal concentrations. The sampling was well distributed all over the site.

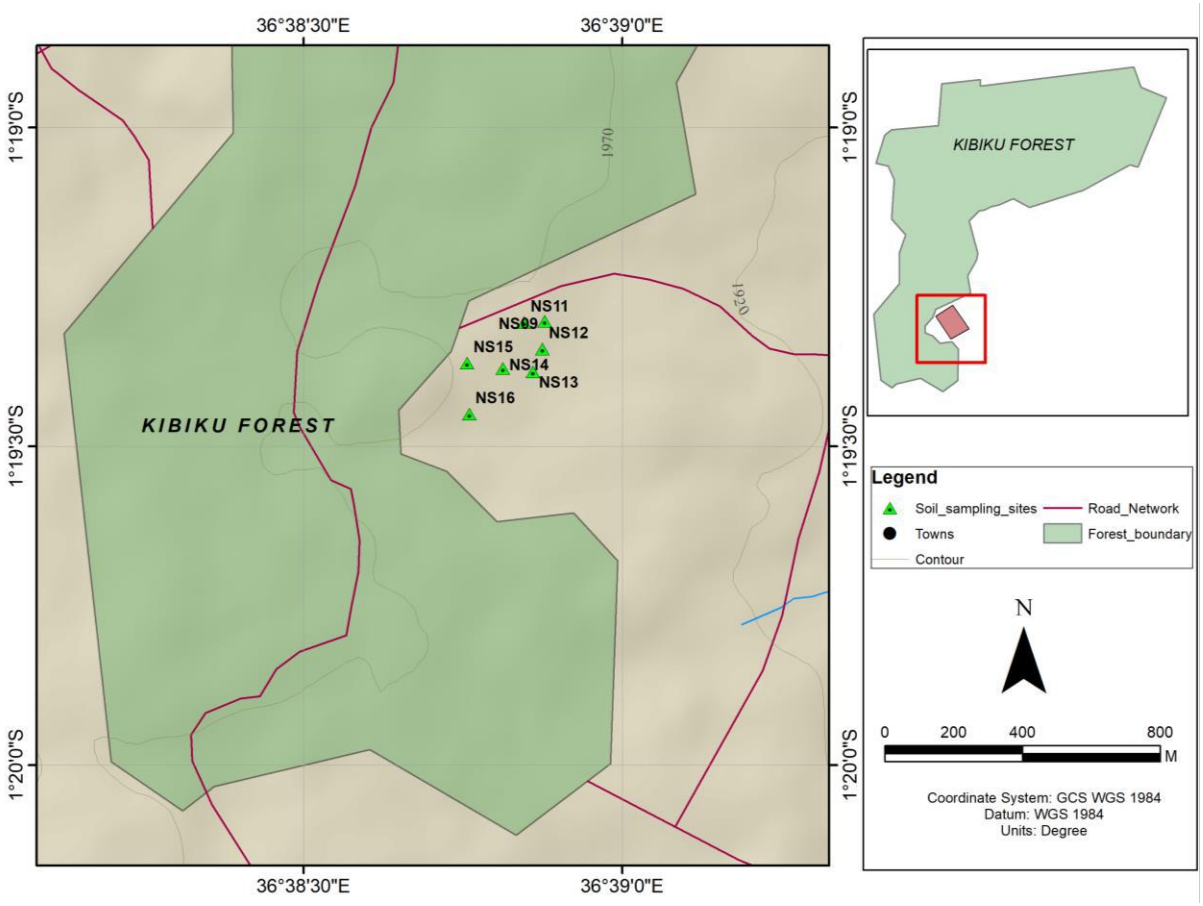

Figure 2: Map of the study site with sites from where soil samples (NS 9- NS16) were collected for laboratory analysis

2.4.3.2. Water quality analysis

Physical and chemical parameters were determined in situ and water samples collected from all the water resources we could find in Kibiku area covering streams, boreholes and tap water. The samples were transported to the laboratories for analysis of nutrient and heavy metals concentration determination.

2.4.3.3 Air quality analysis

The air sampling was done between 5th and 21st April, 2018. Sampling was done in situ using a portable gaseous sampling meter. Gas samples were also collected for laboratory analysis. Test for methane, carbon dioxide, carbon monoxide, acidic gases, particulates and temperature was carried out.

CHAPTER THREE
BASELINE INFORMATION

3.1 Introduction

The topographic assessment is examined, the flora and fauna of the area is described, current status of water, air and soil quality examined and the socioeconomic status of the population around the site evaluated.

3.1 Topography

The topography of the area is characterised by gently sloping land.The project site lies at about 1844 meters above sea level. The ground landscape is generally flat being part of the Ebulbul Kerarapon plain, rising to the west steeply to form Ngong hills (Topographical survey).

3.2 Kibiku forest

The site is located next to Kibiku forest. Kibiku forest is located in Kajiado County and it's about 25Km from Nairobi city. It is a dry highland Forest that forms part of the Ngong Hills forest lying on the southern part of Ngong Town, in Kajiado County. The Forests Act 2005 and the draft Forest policy ushered in a new era in forest management in Kenya, with a dispensation that allows the involvement of forest adjacent communities in their management. The legislation of the forest policy was a turning point in the way forest resources are managed. The policy provides for the establishment, development and management of forest resources for the country's socio-economic development.

Forests play a vital role in the livelihood of the population through the provision of invaluable goods and services. The most significant contribution is wood energy (bio-energy) supply for domestic and industrial processes, provision of timber for construction. Forests also play a significant environmental role where trees stabilize soils, regulate ground water flow, act as an important water catchment. For instance Kibiku is the source of Motione River which empties into the Ngong river. It also plays an important role of moderating climate by absorbing the greenhouse gases. Forests also support agricultural activities such as grazing. (Plate 3).

Plate 3 Cattle grazing at the proposed site (Fieldwork, 2018)

Kibiku forest has a rich diversity of flora and fauna. The flora is made of exotic and indigenous species. The fauna consists of wild, mammals, birds, reptiles' amphibians and insects.

Flora

The vegetation of Kibiku forest includes exotic and indigenous trees. The exotic trees were introduced by the Kenya Forest Service (KFS) to replenish the decreasing forest. The

indigenous tree species are; *Brachylaena huillensis, Olea africana, Calodendrum capensis, Croton megalocarpus, Warbugiau gandensis, Juniperous procera, Schrebera alata* mixed with bush land made of *Lantana camara, Sesbania sesban, Solanum mauritania* herbs and grasses as seen in (Plate 4 and 5)

Plate 4 Exotic and indigenous plants species interspersed together in the interior part of the forest (Fieldwork, 2018)

Forest Structure

The forest structure is a tropical dry forest made of different layers. The main canopy is a closed cover made of *Croton megalogarpus* and *Brachylaena hulliensis Schrebera alata* mixed with *Eucalyptus paniculata, E. saligna* species and *Cupressus lustanica* on the forest edges.

The Forest edges are mainly covered by Exotic trees such as Eucalyptus species and the regenerating *Croton megalocarpus* plus several invasive species such as *Solanum mauritania* the interior of the forest has mature indigenous species representing the original undisturbed forest from the growing population (Plate 5).

Plate 5 Kibiku Forest Edge near the proposed project site (Fieldwork, 2018)

The forest structure is made of different layers; the main canopy is made mature tall trees like Eucalyptus *Brachylaena hulliensis, Olea africana, Calodendrum capensis, Croton megalocarpus, Warbugiau gandensis.*

Plate 6 Forest layering from undergrowth to forest canopy (Fieldwork, 2018)

The middle canopy is made of *Croton megalocarpus, Warbugiau gandensis Olea africana, Rhusnatalensis and Carisa edulis.* The lower canopy is made of bushes like *Lantana camara, Cassia* spp. *Sesbania sesban* and *Solanum mauritanium.*

Plate 7 Plant species *Sesbania sesban* (Fieldwork, 2018)

The ground canopy has herbs such as *Abutilon grandiflorum, Urtica massaica* (stinging nettle) *Cyathula cylindrica* and grasses. The emergent layer has *Eucalyptus* spp, *Schrebera alata, Junipe risprocera, Brachylaena hulliensi*s and *Pinuspatula* (Plate8).

Plate 8 Ground Canopy (Fieldwork, 2018)

Plate 9 Tree stands *Eucalyptus* at the proposed project site (Fieldwork, 2018)

The area has open grasslands which are used for grazing by the local Maasai communities (Plate 3).

Fauna

Kibiku forest is rich in biodiversity that includes different species of birds and numerous insects, amphibians, reptiles and mammals. The birds include the rare African crowned Eagle (*Stephanoaetus coronatus)* and the spectacular Hoopoe *(Upupa epops)*(plate 10 and 11).

Plate 10 African crowned and Eagle and Plate 11 Hoopoe *(Upupa epops)*

Other bird species are Hammerkops, (*Scopus umbretta*). Doves, cormorants Ibises, Goose, Ducks, Vultures, Kites, Buzzards, s, Plovers, Sandpipers, Doves, Pigeons, Turacos, Owls, Cuckoos, Swifts, Kingfishers, Bee-eaters, Mouse birds, and wood peckers whose knocking sound cannot be missed any day in the forest

The forest also has several species of mammals like Bush Buck (*Tragelaphus scriptus*), Dikdik (*Madoqua kirkii*), Duiker, *Cephalophu snatalensis*, Suni (*Neotragus moschatus*), Aardvak (*Orycteropus afer*), Hedgehog, (*Alterixal biventris*). The large carnivores like Leopard, Hyena are reported to be occasionally spotted.

Plate 12 Bush Buck (*Tragelaphus scriptus*)

Amphibians include Toads and frogs, reptiles such as, tortoises, lizards like the three horned chameleon (*Chameleon jacksoni*) are present in the forest. Blue lizards together with green and brown tree snakes seen darting around the forest floor when one approaches. The large snakes like puff adders, rock pythons are well camouflaged in thick vegetation, all these species together, create a stunning food web. Therefore this ecosystem should be as much as possible protected for its rich biodiversity.

3.2 Social Economic Survey

The socio- economic survey was carried out for the area surrounding Kerarapon estate. The project area is made up of mixed residential on the one hand there are low income residential area and the other high income, therefore people living around the project area are dependent on various livelihoods. In order to come up with the projected effects of the proposed project to the population around the projected area, a socio economic baseline survey was carried out in May, 2018.

The main focus of the study was to come up with:

a) Proper identification of the Project Affected Persons (PAP) , this also involved identification of people not directly affected by the project but living around project sites,
b) To find out sources of income and occupation of the people living around the project area,
c) To establish the number of household members who would be affected by the project,
d) Levels of education of the household head and other members of the household,

e) Status of water and sanitation in the project area
f) Views of the community on the proposed project
g) Expectations of PAP on the development of IWMF and
h) Potential challenges expected when the IWMF start operating in the area.

The socio- economic survey was carried out for the area surrounding the Vet Farm. The site is entirely in high income residential areas, people living in the project area work in various sectors. In order to come up with the projected effects of the proposed project to the population around the projected area, a socio economic baseline survey was carried out in May, 2018.

3.1.2 Kerarapon Residents Association

The Kerarapon Residents association was represented by Mr. Robert Ouko who gave a very informative insight in relation to the proposed site for the waste facility. This was due to his active participation at the community as a member of Water Resource Users Association- with the region being attributed to being the source of Mbagathi and Ngong' river as well as being a member of the development committee of Kerarapon. Plate 13 depicts an interview with a Kerarapon Association Representative.

Plate 13 Interview with Kerarapon Association representative

On his view which he insisted was a reflection of the Kerarapon stand, he indicated that public awareness on the waste facility had not been conducted in the area and thus would not receive full community support unless the community was actively engaged and educated in relation to the project proposal. In his view, questions were arising as to why the project could not be taken to areas such as Oloshoibon and Kimuka where there was less human settlement. Another issue raised during the interview was the need to know that the facility

had worked somewhere else that residents could refer to in the event of queries. The land at the proposed project site belonged to indigenous Maasais called Kekonyokes (the original inhabitants of the land before donating it to the government), for the project to highest benefits, this community should be considered in benefit sharing to avoid anticipated conflicts. Other issues of the Kerarapon residents association was how the project would handle the water pollution, dust, smell, birds, scavengers and insecurity problems always associated with waste facility world over. Asked about the quarry being an alternative site, Mr. Ouko said that, such an idea would face even fiercest opposition due to the fact that there was a court case in relation to the site, which was resolved outside court with an agreement that the site should not be turned into a waste management facility.

3.1.4 The views of County officials of Kajiado County

Implementation of Kajiado plan on sustainable environmental management focuses on the need to rehabilitate, restore and manage Ngong' River Ecosystem in order to provide for improved livelihoods. The County of Kajiado is also concerned with the type of technology to be implemented at the site. The technology should have minimum or zero impact to the surrounding environment and be environmental and user friendly to ensure its sustainability (Plate14)

Plate 14 An interview with the Kajiado County Director and deputy director of environment

3.2 Summary of findings from the Socio-Economic Survey

The findings were based on 43 respondents, representing the total target population The respondents included surrounding learning institutions; waste generators, waste dealers/brokers/wholesalers, residents, neighbourhood, community associations/groups, CBOs and churches including recyclers and Vet farmers at Kerarapon area.

Gender of respondents

The gender of respondents interviewed at Kerarapon and surrounding areas where the Integrated Waste Management Facility will be constructed constituted 80% males and 20% of females.

The level of Education of the respondents

The highest level of education for the majority of respondents living around Kerarapon area was secondary school by 34% of the respondents and primary school by 27 % and a sizeable number (32%) had attained tertiary level of education(table 2).

Table 2 Education Levels

EDUCATION LEVEL OF RESPONDENTS	Percentage (%)
None	7
Primary	27
Secondary	34
Tertiary	32
TOTAL	100

1. Respondents residential areas

The majority of the sampled households constituted the low income category (36%) whereas the middle income was 32% and 29% from high income (Table 3).

Table 3 Residential areas of the respondents

RESIDENCE	Percentage (%)
Low income area	36
Middle income areas	32
High income areas	29
Other	3
TOTAL	100

2. Respondents Length of stay in Kerarapon

It was indicated that 37% of the residents have lived in Kerarapon area for between 6-10 Years; with 23% having lived in the area for more than 11years and 35% for 1-5 Years the remaining 5% have lived here for less than 1 year (Table 4).

Table 4 Length of stay at Kerarapon area

Period of stay	Percentage (%)
Less than 1 year	5
1-5 years	35
6-10 years	37
More than 11 years	23
TOTAL	100

3. Sources of income for respondents

According to the study small businesses were the main sources of income for Kerarapon residents (43%), casual employment was the second main source of income at 24%, and casual employment was at 24% and skilled 21%. Additionally it was reported on interview that the majority of the youth earn an average of Ksh. 200 (2.0 USD) per day. This income is not adequate to sustain their daily expenses (Table 5).

Table 5 Sources of income for Kerarapon residents

Sources of income	Percentage (%)
Small Business	43
Formal employment	12
Casual employment	24
Skilled employment	21
TOTAL	100

4. Occupation of respondents

The main occupation for the residents of Kerarapon residents' was small scale business at 29%, casual labour by 15% of the respondents, skilled labour by 24% of the respondents, formal employment by 12% of the respondents. However a sizeable number of respondents

were unemployed (20%). Thus the respondents' main occupation has been small scale business, casual labourer and skilled labourer. Therefore the development of IWMF at Kerarapon should open up opportunities for unemployed group to improve their livelihood the job opportunities should cater for all residents irrespective of their levels of education (Table 6).

Table 6 Occupation of the respondents

Occupation	Percentage (%)
Small scale Business	29
Formal employment	12
Casual labourer	15
Skilled labourer	24
Unemployment	20
TOTAL	100

5. Sources of wastes in Kerarapon

The respondents indicated that 67.5% of the wastes are collected from residential areas and the rest (32.5%) from commercial establishments, industries and construction sites (Table 7).

Table 7 Sources of waste in Kerarapon

Sources of waste	Percentage (%)
Household/residential	67.5
Commercial establishments/Industry	31.1
Construction sites	2.4
TOTAL	100

6. Ways of collecting waste

Waste collection in the town is done by the county government (17%), private waste collectors or CBO's, 87%. (Table 8).

Table 8 Ways of collecting waste in Kerarapon

How waste is collected at Kerarapon	Percentage (%)
County government	17
Private waste collectors/BOS	83
TOTAL	100

7. **How waste is disposed by respondents**

Among the respondents, 40% of the households practice open dumping, 20% use compost pits, 20% use back yard disposal, 10% road side disposal and 7% trenches and only in 3% of household waste is collected for final disposal at Ngong' dumpsite. In low income areas, 40% use open dumping. This underscores the need of having central collection points within Kerarapon area to address the challenge of initial waste disposal. Eighty two (82%) of the household respondents do not separate waste at the source with the majority being at low income areas. This can be attributed to lack of information, knowledge, skills and benefits of waste separation at the source (Table 9).

Table 9 Waste disposal mechanism at Kerarapon

How waste is disposed at Kerarapon	Percentage (%)
Open dumping	40
Use of compost	20
Roadside disposal	10
Trenches	7
Back yard disposal	20
Household waste is collected for final disposal	3
TOTAL	100

8. Payment for waste collection services

The majority of the sampled households do not pay for waste collection services, 36%, 32%, 29% and 3% of household in low income, middle income, high income and peri-urban areas respectively do not pay for waste collection. The high number of households that do not pay for waste collection in low income areas can be attributed to inadequate sources of livelihood.

Averagely low, middle and high income household pay Kshs, 100, 200 and 400 and more respectively for waste collection services. Averagely, households in Kerarapon pay Kshs.200

per day for waste collection services. This survey revealed that the households who do not pay for the collection services (54%) were however willing to pay for the collection services. This therefore means that there are opportunities for investment in waste collection hence job creation and source of livelihoods especially in low income and peri-urban areas where employment is a major concern (Table 10).

Table 10 Payment of waste collection services

Current amount paid for waste collection in Ksh.	Percentage (%)
50	None
100	7
200	25
400 and more	14
Do not pay	54
TOTAL	100

9. Awareness on the meaning of Integrated waste management

It is only 35 % of the respondents that reported to understand the meaning of integrated solid waste management as they have indicated. The majority (65%). indicated that they do not understand what an IWMF meant and how it will improve the environment. Thus Capacity building and promotion of community involvement and participation is highly recommended for the residents to elicit their support for the development of the facility.

10. Commissioning of IWMF at Kerarapon

Those supporting the commissioning of IWMF plan feel that the facility will reduce respiratory and water borne diseases, reduce scavengers, promote a clean and healthy environment, reduce fire outbreaks, reduce child labour, improve infrastructure in the area and provide conducive learning environment and habitation and will lead to a reduction of toxic loaded food crops. However, they believe that this facility will lead to an influx of heavy trucks in the area of operation.

11. Main sources of water for Kerarapon residents

In Kerarapon area the main source of water is available as supplied piped water (Table 11). Those supplied via stand pipe in their dwelling was 50% of the respondents whereas those supplied in the

yard was 23% of the respondents and 27 % of the respondents reported their main source water as public tap.

Table 11 Sources of water for Kerarapon residents

Sources of water	Percentage (%)
Stand pipe in the dwelling	50
Stand pipe in the yards	23
Public tap	27
TOTAL	100

12. Views about relocation of the Ngong dumpsite and development of IWMF.

The majority (74%) of the respondents are not aware about the relocation of the dumpsite and development of IWMF at Kerarapon, the rest 26% reported to be aware. Those who are aware and supporting the plan feel that closure of the dumpsite will reduce respiratory and water borne diseases, reduce scavengers, promote a clean and health environment, reduce fire outbreaks, reduce child labour, improve infrastructure in the area and provide conducive learning environment and habitation and will lead to a reduction of toxic loaded food crops (Table12).

Table 12 Views about relocation of Ngong dumpsite and development of IWMF at Kerarapon

Awareness	Percentage (%)
Aware	26
Not aware	74
TOTAL	100

17. Waste management Challenges expected at Kerarapon

The study sought to establish the level of the respondents' attitude on various issues regarding challenges expected at Kerarapon area. The level of agreement was measured on a Likert Scale of 1-5 where 1= Strongly Disagree (SD), 2= Disagree (D), 3= Not sure (NS), 4= Agree (A) and 5= Strongly Agree (SA). Interpretation was done as follows: 1-1.5: Strongly Disagree; 1.6-2.5: Disagree; 2.6-3.5: Not Sure; 3.6-4.5: Agree and 3.7- 4.5: Strongly Agree.

The study established that the respondents agreed that the overall, integrated waste management facility will be the best option for waste management (*M*= 3.7). The respondents

strongly agreed that rapid urbanisation will be a great challenge as evidenced by (*M*= 4.6). The respondents agreed that lack of awareness on the operation of the facility will be a challenge (*M*= 4.5) and they further agreed that limited human resources and financial capacity will be a great challenge (*M*= 4.2). However the respondents were not sure whether ineffective laws on waste management failure of garbage collection, transportation, recovery and disposal systems would be a great challenge (M=3-6). Most respondents disagreed on whether weak organisational structure will pose a challenge on waste management (*M*= 2.2) (table 13).

Table 13 Waste management challenges expected at Kerarapon

Statements	Mean
Rapid urbanisation	4.6
Limited human capacity and financial resources	4.2
Weak organisational structure	2.2
Ineffective laws on waste management failure of garbage collection, transportation, recovery and disposal systems	3.6
Lack of public awareness	4.5
Lack of framework for public private partnership	3.2
Emergency of new streams of waste (E-waste, ELVs, sanitary waste	3.7
Overall mean	**3.7**

18. Best way to manage waste at Kerarapon

The study lastly sought to establish the perception of the respondents on various issues regarding best way to manage waste at Kerarapon area. The level of agreement was measured on a Likert Scale of 1-5 where 1= Strongly Disagree (SD), 2= Disagree (D), 3= Not sure (NS), 4= Agree (A) and 5= Strongly Agree (SA). Interpretation was done as follows: 1-1.5: Strongly Disagree; 1.6-2.5: Disagree; 2.6-3.5: Not Sure; 3.6-4.5: Agree and 3.7- 4.5: Strongly Agree.

The study established that the respondents agreed that overall, integrated waste management facility will be the best option for waste management (*M*= 3.8). The respondents strongly agreed that the promotion of 3R's principle (reduce, re-use and recycling of waste should be practised as evidenced by (*M*= 4.6). The respondents also agreed that capacity building is

highly recommended at the proposed project site (*M*= 4.5, *SD*= 0.53) and that resource mobilisation is recommended for efficient operation of the IWMF facility (*M*= 4.3). The respondents further agreed that the waste should be reduced at the sources (*M*= 4.1).The respondents were not sure whether promotion of community involvement and participation was the best option on waste management (M=3-6) However respondents disagreed on financing reforms as the best option in waste management (*M*= 2.2). In conclusion the respondents show that having an Integrated Waste Management Facility in the area will help sort the environmental issues associated with the open dumpsite (Table 14).

Table 14 Views on best way to manage wastes at Kerarapon

Statements	Mean
Waste reduction at the sources	4.1
Waste recycling and compositing	4.2
Planning for sustainable solid waste management system	3.6
Institutional and organizational reforms	4.1
Capacity building	4.5
Management of hazardous and special waste, medical waste, waste tyre and End of Life vehicles	4.1
Environmental planning	3.2
Resource mobilisation thro' public private partnerships	4.3
Financing reforms	2.2
Promotion of community involvement and participation	3.6
Promotion of 3R's principles(reduce, re-use & recycle	4.6
Overall mean	**3.8**

CHAPTER FOUR
RELEVANT POLICY LEGISLATIVE AND REGULATORY FRAMEWORK

4.1 Introduction

National, Legal and Institutional Framework Kenya has approximately 77 statutes that guides on environmental management and conservation. Most of these statutes are sector specific, covering issues such as public health, soil conservation, protected areas conservation and management, endangered species, public participation, water rights, water quality, air quality, excessive noise control, vibration control, land use among other issues. The National Environment Management Authority (NEMA) in conjunction with the various lead agencies studies proposed projects to ensure all aspects of the proposed project adheres to all Institutional Frameworks requirements. The institutional framework directly governing dumpsites projects are: Environmental Management and coordination Act (EMCA) of 1999 and its subsequent supplements the Environmental Regulations (Impact Assessment and Audit) Regulation, 2003; EMCA (Waste Management) Regulations, 2006 and EMCA (Water Quality) Regulations, 2006; EMCA (Controlled Substance) Regulations, 2007; EMCA (Noise and Vibration Control) Regulations,2009; EMCA (Emissions Control) Regulations,2006; EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009 and EMCA (Conservation of Biological Diversity and Resources, Access To Genetic Resources and Benefit Sharing) Regulations, 2006, Land Acquisition Act (Cap.295), Land Act Way Leaves Act (Cap. 292), Public Roads and Roads Access Act (Cap. 399), Forest Act, Physical Planning Act (CAP 286), Local Government Act (CAP 265), Traffic Act Chapter 295, Public Health Ac (Cap. 242), Lakes and River Act Chapter 409, and the Penal Code (CAP 63) 514. The project should adhere to these legislations.

4.1.1 Environmental Management and Coordination Act of 2015

This project report shall be undertaken in accordance with the Environment (Impact Assessment and Audit) regulation 2003, which operationalize the environment management and coordination act 1999. The report shall be prepared in conformity with the requirements stipulated in the environmental management and coordination act no 8 of 1999 (EMCA) and the Environmental Impact Assessment and audit regulations 2003 regulation 7 (1) and the second schedule. Part II of the said act which states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. In order to achieve the goal of a clean environment for all, new projects listed under the second schedule of Section 58 of EMCA No 8 0f 1999 shall undergo an Environmental Impact Assessment. This includes

development activities such as this new project. In additional to the legal compliance above, the following legal aspects shall also be taken into consideration or will be taken into consideration before commencement of the project.

4.1.2. Occupational Health and Safety, 2007

The said Act requires that before any premises are occupied or used a certificate of registration should be obtained from the chief inspector. The occupier must keep a general register with provision for health, safety and welfare of workers on site. Public Health Act Cap 242 Part IX section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health section 116 requires that local authorities take all lawful necessary and reasonable practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to injuries or dangerous to human health. This will have to be provided for this project. Physical Planning Act, 1999 the said Act section 29 empowers the local authorities to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same section allows for prohibition or control of the use and development of an area. Land Planning Act Cap 303 Section 9 of the subsidiary legislation (the development and use of land Regulations 1961) under which it requires that before the local authority submits any plans to the minister for approval, steps should be taken as may be necessary to acquire the owners of any land affected by such plans. Particulars of comments and objections made by the landowners should be submitted, which intends to reduce conflict of interest with other socio economic activities.

Other Relevant Laws include EMCA (Waste Management) Regulations, 2006. These Regulations guides on the appropriate waste handling procedures and practices. It is anticipated that, the proposed project will have to deal with large quantity of solid waste dumped over the years since the inception of the dumpsite. According to the regulation, waste should be; segregated and grouped according to their similarity for example plastics, toxic, organic etc; all waste should be deposited in a designated dumping area approved by the local authority; all waste handlers engaged by the proponent should be licensed by NEMA and possess all relevant waste handling documents such as waste transport license, tracking documents, license to operate a waste yard, insurance cover, vehicle inspection documents among others; all hazardous wastes are labeled as specified in section 24 (1-3) of the regulation. The fourth schedule lists wastes considered as hazardous and solvents, emulsifiers/emulsion, waste oil/water and hydrocarbon/water mixtures. EMCA (Noise and

Vibrations Control) Regulations, 2009 These Regulations provides guidelines for acceptable levels of noise and vibration for different environments Section 5 of the regulation warns on operating beyond the permissible noise levels while section 6 gives guidelines on the control measures for managing excessive noises and copy of the first schedule indicating the permissible noise levels for different noise sources and zones. The project team should observe the noise regimes for the different zones especially when working in areas termed as silent zones which are areas with institutions and worship places. These areas are permitted exposure to sound level limits of not exceeding 40 db (A) during the day and 35 db (A) at night. The regulation states that a day starts from 6.01 a.m. to 8.00 p.m. while night starts from 8.01 p.m. – 6.00 a.m. during the day and night levels are maintained at 35 db Part III of the regulation gives guidelines on noise and vibration management from different sources. Sections 11, 12 and 13 of the stated part give guidelines on noise and vibration management from machines, motor vehicles and night time construction respectively. Section 15 requires owners of activities likely to generate excessive noise to conduct an ESIA to be reviewed and approved by NEMA. EMCA (Air Regulations), 2014.

This Act is meant to ensure that all activities at least maintain ambient quality standards of air and any pollution to air (in particulate matter, dust or obnoxious and poisonous gases) needs to be sufficiently mitigated. County Governments Act, 2012 This Act delineates the roles and responsibilities of county governments with their administrations as well as the role of county citizens in public participation and consultations regarding projects at the county level. CPP is part of this project involving the county government and other stakeholders. HIV Aids Prevention and Control (Cap 246A) This Act is to promote public awareness about the causes, modes of transmission, consequences, means of prevention and control of HIV and AIDS. It also seeks to positively address and seek to address conditions that aggravate the spread of HIV infection. In the Ngong' dumpsite project, there will be awareness creation and sensitization on the workers and other persons on the risks of infections and fostering prevention and control. It is also recommended that condoms for use by workers will be availed at site to prevent infections.

4.1.3 National Policy Framework.

Several policies have been developed over the years to guide the development and management of proposed projects to ensure both economic and social sustainability these policies include; The National Poverty Eradication Plan (NPEP) The objective of the NPEP is to reduce the incidences of poverty in both rural and urban areas by 50 percent by the year

2015, as well as to strengthen the capabilities of the poor and vulnerable groups to earn income. It also aims to narrow gender and geographical disparities and create a healthy, better-educated and more productive population. This plan has been prepared in line with the goals and commitments of the World Summit for Social Development (WSSD) of 1995. Environmental & Social Impact Assessment Project Report for the Ngong' dumpsite in in Kajiado County of Nairobi Metropolitan Region 21 The plan focuses on the four WSSD themes of poverty eradication; reduction of unemployment; social integration of the disadvantage people and creation of an enabling economic, political, and cultural environment which can be achieved through developing proper sanitation. The plan will be implemented by the Poverty Eradication Commission (PEC) formed in collaboration with Government ministries, Community Based Organization (CBO), private sector, Non-Governmental Organization (NGO), bilateral and multilateral donors. 2.9.3 The Poverty Reduction Strategy Paper (PRSP) The PRSP has the twin objectives of poverty reduction and enhancing economic growth. The paper articulates Kenya's commitment and approach to fighting poverty; with the basic rationale that the war against poverty cannot be won without the participation of the poor themselves. The proposed project through improving sanitation in the area will, contribute towards economic growth.

National Environmental Action Plan (NEAP) for Kenya was prepared in mid 1990s. It was a deliberate policy whose main effort is to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources forms an integral part of societal decision-making. The application of this plan is widening as the government through NEMA does not approve a development project unless the impacts of the proposed project are evaluated and mitigation measures proposed for incorporation in the project's development plan which is in line with the requirements of the NEAP.

Environmental and Development Policy (Session Paper No.6 1999), as a follow-up to the foregoing, the goal of this policy is to harmonize environmental and developmental goals so as to ensure sustainability. The report provides comprehensive guidelines and strategies for government action regarding environment and development. It is recommended that the requirements of this policy are observed, as much by taking measures to enhance the water catchment by replanting trees, using clean energy to reduce deforestation, undertaking environment friendly practices during project implementation, take measures to reduce

pollutants leading to eutrophication of water bodies both above- and underground water bodies; and Rehabilitate project affected areas and public infrastructure among others

4.1.4 International Policy Framework

Kenya is a signatory as well as a party to various international conventions, treaties and protocols relating to the environment which aims at achieving sustainable development. According to the Registrar of International Treaties and other Agreements in Environment (UNEP 1999), there are 216 treaties, 29 of which are of interest to Kenya. The country is a signatory to 16 such agreements, which range from use of oil, protection of natural resources and protection of the atmosphere. The agreements are both regional and international and become legally binding on Kenya upon Environmental & Social Impact Assessment Project Report for the dumpsite in Ngong' in Kajiado County of Nairobi Metropolitan Region. Ratification thereof by the rightfully designated Kenyan Authority. The agreements of interest to Kenya can be categorized as those for protecting natural resources, atmosphere and social wellbeing of man.

The responsibility of the National Environmental Management Authority (NEMA) is to exercise general supervision and, co-ordination of all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment. The Authority shall review the project report for the proposed project, visit the project site to verify information provided in the report and issue an ESIA license if it considers that all the issues relevant to the project have been identified and mitigation measures to manage them proposed.

World Bank Environmental and Social Safeguard Policies

Like in any project financed by, or with financial participation of, the World Bank, the environmental and social impact assessment safeguards as defined in the Bank's Operational Procedures (OPs) will be respected for the purposes of this project implementation. The WBG EHS guidelines as stipulated by the Bank should be strictly adhered to in this project and the more stringent between the Bank's and local legislation should be complied with. WB classifies its projects into four Environmental Assessment categories according to the likely impacts on the environment they will have. This classification is as follows (only main conditions mentioned): (a) Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts. (b) Category B: A proposed project is classified as Category B if it's potential adverse environmental impacts on human

populations or environmentally important areas— including wetlands, forests, grasslands, and other natural habitats—are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigation measures can be designed more readily than for Category A projects. Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project. (d) Category FI: A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts. This project is categorized as F1.

CHAPTER FIVE
PUBLIC PARTICIPATION

5.1 Introduction

The public consultation was carried out with key stakeholders of the project and the persons affected by the project and the communities living around the dumpsite. Specifically consultants were held with the following institutions, and their views were captured. The key stakeholders included;

- Ministry of Environment and Mineral Resources
- Kajiado County environment director
- National Environment Management Authority
- Kajiado County government
- Kenya Wildlife services
- Kenya Forest Services
- Water Resources Management Authority

The following are examples of projects that were never fully implemented due to lack or poor public participation. They include:

- Asticom: Signed MOU for construction of a recycling facility stalled due to technicalities.
- Construct Consultant Ltd: Signed MOU to establish Solid waste recycling facility, benchmarked in Pakistan but identified site was found to be unsuitable for the proposed recycling plant and handling.
- NCA (Norwegian): Sustainable charcoal production policy.
- Private Refuse Handlers: Enabling environment for private entities to undertake refuse collection in major towns.
- NIA (Neighbours Initiative Alliance): Collaborated in operation of sand harvesting regulation and sustainable charcoal harvesting policy.
- City of Umea in Sweden: Collaborated in Governance for Integrated Environmental System on Waste and Water management, funded by the International Centre for Local Democracy.
- UN Habitat under Danish: Have held meetings with a view of possible collaboration for construction of a landfill.

- WWF (World Wildlife Fund): Collaboration in provision of predator lights and renewable energy – biogas technology to the rural community.

Focused group discussions were held with persons affected by the project

- Communities living around the Kerarapon Vet farm
- Religious leaders
- Heads of schools around the Kerarapon Vet farm
- Veterinary farmers

5.2 Key stakeholders' environmental concerns

a) Ministry of environment and natural resources is in support of the project

b) Kajiado County government is in need of proper waste management

c) The dumpsite has been a source of pollution for Ngong' river

d) The Kajiado county should ensure that there will be proper management of the new Integrated Waste Management facility proposed at Kerarapon

e) An integrated approach in the management of the system should be established as a result of lessons learned from the previous system

Water resources Management Authority

a) WARMA is concerned with the quality of water both surface and ground water

b) The project should ensure that ground water is not polluted and the discharge to the river as a result of sanitary landfill is of good quality that it does not pollute the river even more

Ministry of transport

It is important to have a clean town to enable the town to competitively compare to other towns.

Athi Water Service Board

Ngong' River has been contaminated by wastes from Ngong' town. The dumpsite has been a source of solid waste polluting Ngong' River.

Main issues about public participation

The public consultations introduced the stakeholders to project by informing them of the Kajiado county intention's to close down the Ngong' Dumpsite. This was carried out effectively and all the people involved in all activities at the dumpsite are aware of this plan.

The persons affected by the project were very concerned about the loss of their source of livelihood; the study held a series of meetings with individuals registered groups, middlemen and the entire group. The persons affected by the project would like to be compensated to enable them find another source of livelihood

The persons affected by the project at Ngong' dumpsite are vulnerable. They include youth, orphaned, households, female headed houses, and young children under 18 years, elderly women and elderly men.

The key concern was future source of livelihood since they have been relying on the dumpsite for many years. Majority have basic education and thus has no capacity to venture in to other areas form of livelihood. The groups are also represented by the majority of the youth have young families who have previously involved in criminal activities and have reformed as a result of venturing into businesses at the dumpsite.

It was observed that the number of female-led households, orphaned and young children working at the dumpsite is high. These are already vulnerable households, removing the dumpsite with them without proper plans to restore the households would make them even more vulnerable.

CHAPTER SIX
ENVIRONMENTAL AND SOCIAL IMPACT AND MITIGATION MEASURES

6.1 Introduction

The proposed development is located very close to the Kibiku forest, in a large veterinary field. Some distance from the site is a quarry from where road construction materials are excavated. The proposed site, therefore, though appearing pristine, has had impacts from the surrounding activities including the recent construction of the Standard Gauge Railway (SGR) line with attended effects on water resources, soil and air quality. The integrity of the country's environment, biodiversity and agricultural productivity is sustained by these very resources. Therefore, as part of the ESIA study, a survey was done to provide data that will act as reference for monitoring of the environmental resources in future. Water samples were collected from five sites, soil from eight sites and air from three locations.

6.2.1. Measurement location description

The site was mapped using state of the art geographical information system and aerial drone with sampling sites coordinates recorded for precision purposes.

6.2.2. Measured Parameters

The parameters measured in ambient air at the proposed project site were:

- Sulphur dioxide
- Nitrogen dioxide
- Hydrogen sulphide
- Carbon dioxide
- Humidity
- Temperature
- VOCs

6.2.3. Sulphur dioxide and nitrogen dioxide

Sulphur dioxide (SO_2) is a colourless, water-soluble gas that is reactive and has a pungent odour. Sulphur dioxide is detectable to the human nose at concentrations of around 0.5–0.8 parts per million (1400–2240 μgm^{-3}). Concentrations of SO_2 in ambient air typically occur as a result of combustion processes, in particular the burning of high sulphur fuels, although specific industries such as manufacturing fertilizer also discharge SO_2. Sulphur dioxide is subject to a series of transformation processes in the atmosphere, which can result in, sulphurous and sulphuric acids, sulphites and sulphates being formed.

Sulphur dioxide causes irritating effects by stimulating nerves in the lining of the nose and throat and the lung's airways. This causes a reflex cough, irritation, and a feeling of chest tightness, which may lead to narrowing of the airways. This latter effect is particularly likely to occur in people suffering from asthma and chronic lung disease, whose airways are often inflamed and easily irritated.

Asthmatics are generally considered the most sensitive group in the community to concentrations of SO_2. Other sensitive groups include those exercising. This is because SO_2 is very reactive and consequently the distribution of SO_2 along the conductive airways of the respiratory tract is non-uniform, depending on breathing volumes and types.

6.2.4. Nitrogen dioxide

NO_2 is a reddish-brown gas with a pungent and irritating odour. It transforms in the air to form gaseous nitric acid and toxic organic nitrates. NO_2 also plays a major role in atmospheric reactions that produce ground-level ozone, a major component of smog. It is also a precursor to nitrates, which contribute to increased respirable particle levels in the atmosphere. NO_2 can irritate the lungs and lower resistance to respiratory infection. Sensitivity increases for people with asthma and bronchitis. NO_2 chemically transforms into nitric acid and, when deposited, contributes to Lake Acidification. NO_2, when chemically transformed to nitric acid, can corrode metals, fade fabrics and degrade rubber. It can damage trees and crops, resulting in substantial losses

Table 15 Health effects of different Air Quality Index (AQI) levels caused by nitrogen dioxide

Category	AQI	Pollutant Concentration Breakpoints (ppb)	Nitrogen Dioxide (NO_2)
Very Good	0 - 15	0 -50	No health effects are expected in healthy people.
Good	16 - 31	51 -110	Slight odor.
Moderate	32 - 49	111 – 200	Odor.
Poor	50 - 99	201 – 524	Air smells and looks brown. Some increase in bronchial reactivity in asthmatics.
Very Poor	100 or over	525 or over	Increasing sensitivity for asthmatics and people with bronchitis.

6.2.5. Hydrogen Sulphide

Hydrogen, an abundant element that helps power the sun, also forms diverse compounds on earth ranging from water to hydrogen sulfide: a foul-smelling, colorless gas that forms when bacteria decompose dead animal and plant matter in stagnant low-oxygen water. Although hydrogen sulfide causes serious health problems at high exposure levels, it has several important commercial uses ranging from metallurgy to manufacturing.

- **H_2S at a Glance**

Hydrogen sulfide and water have similar structures, but intermolecular forces in H_2S are weaker than those in H_2O. These weaker forces cause hydrogen sulfide to boil at a lower temperature than water. The human body, volcanic gases, unrefined petroleum and natural gas all contain hydrogen sulfide. This gas is heavier than air so it often accumulates in low-lying areas. Food processing plants, paper mills and other industries can also create H_2S as a byproduct of their production processes.

- Hydrogen Sulfide: Nature's Chemical Helper

The main use for hydrogen sulfide is in the production of sulfuric acid and elemental sulfur. Manufacturers use sodium hydrosulfide, sodium sulfide and similar inorganic sulfides to create products such as pesticides, leather, dyes and pharmaceuticals. H_2S is used to prepare the inorganic sulfides you need to make those products. As a reagent and intermediate, hydrogen sulfide is beneficial because it can prepare other types of reduced sulfur compounds. A reagent is a starting participant in a chemical reaction. In a chemical process, an intermediate is a substance that the process creates. This substance, not the final product, can serve as raw material for the process's next step.

6.2.6. Sampling methodology

The sampling was based on active method as opposed to passive. Direct reading machines were deployed to collect the samples for a period of one hour per location, and average data recorded.

Table 16 Air Quality in the proposed project area (18-22 April 2018) viewed against NEMA guidelines (EMCA, 2014) and WHO Air Quality Guidelines (AQG) Standards.

Sampling Point/Parameter	Near residential (MP4)	Mid field (MP5)	Near gate (MP6)	EMCA, 2014 (Air Quality)	WHO (AQG) *Max*
Coordinates	238311E 9853832N	238234E 9853627N	238142E 9853367N		
Sulphur Dioxide (µg/m³)	BDL	BDL	BDL	80	500
Carbon Monoxide (mg/m³)	0.21	BDL	BDL	2.0	-
Carbon Dioxide (mg/m³)	205	200	200	-	-
Oxides of Nitrogen (mg/l)	BDL	BDL	BDL	0.05	200
Hydrogen Sulphide (µg /m)	BDL	BDL	BDL	150	-
VOCs (µg/m)	BDL	BDL	BDL	600	-
Relative Humidity	82.9%	82.7%	82.9%	-	-
Temperature (°C)	19.0	18.9	18.9	-	-

Sulphur dioxide, hydrogen, sulphide and oxides of nitrogen were below the detection limit. Although concentrations of VOCs and CO_2 were determined, they were well within the expected ranges. Oxides of Nitrogen, Sulphur dioxide and Hydrogen Sulphide were below the detectable levels.

Water and soil quality in the project area

Environmental processes, which include physical, chemical and biological attributes, interact at an ecosystem level to affect biota and the people living within the environment. Nine water quality parameters were determined and analyzed from five sampling points. The water quality parameters analyzed showed that there were variations although generally within the NEMA standards/guideline values. The other water quality parameters of concern in five sampled points were heavy metal concentrations (lead, zinc and cadmium) that exceeded NEMA guideline values and could imply high risk, especially to the domestic animals (cattle, pigs, goats, sheep, etc) that use the water resources. Lead and Zinc were double to 10 times higher than the recommended values in natural ecosystems (Table 20 below).

Table 17 Water quality indicators in the proposed project area (Ngong-Kibiku water (NW) sampled on 5-18 April 2018, viewed against NEMA guideline values (1st Schedule) (nd = Not detected).

Sampling point/Parameter	NW-01 Karinde tap water	NW-02, Kerarapon stream	NW Tap water	NW-03 Tana Athi	NW-05 Gatwe Springs	NEMA Guideline values
GPS Coordinates	37238345E 9853977N	37239674E 9854510N	37239615E 9854532N	37239458E 9849375N	37239674E 9854501N	
Temperature (°C)	20.8	19.8	21.0	20.9	19.4	30
Ph	6.56	6.00	5.46	7.35	6.03	6.5-8.5
Conductivity (μScm^{-1})	408	520	527	862	437	-
Lead (mgl^{-1})	1.74	2.13	2.13	140	86.1	0.05
Zinc (mgl^{-1})	nd	nd	nd	8.3	1.6	1.5
Cadmium (mgl^{-1})	1.86	2.39	2.38	0.06	0.06	0.01
Phosphates ($mgl-^{1}$)	0.689	1.069	0.809	5.2	1.6	-
Nitrates (mg^{-l})	0.268	0.257	0.293	6.1	0.0	10
Total Dissolved Solids ($mgl-^{1}$)	408	520	527	-	-	-

In soil, concentrations of the determined parameters were lower than they were in water, and near background levels. It is likely that the environmental toxicants may find their way into the food chain via bioaccumulation.

Table 18 Concentration of soil quality indicators in the proposed project area (sampled 18-21 April 2018)

Sampling point/Parameter	NS9	NS 10	NS 11	NS 12	NS 13	NS 14	NS 15	NS 16
GPS	3723826E 9853798N	3723882E 9853764N	3723821E 9853795N	3723826E 9853718N	3723823E 9853652N	3723814E 9853662N	37238044E 9853677N	3723805E 985353N
Temperature (°C)	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2
pH	6.51	6.79	7.52	6.84	6.87	6.74	6.74	6.76
Conductivity (μScm^{-1})	43.3	51.1	45.3	44.3	47.7	48.2	58.2	60.0
Lead (mg/g)	15.573	17.734	18.734	25.406	16.194	16.809	19.252	20.06
Zinc (mg/g)	2.741	5.111	3.778	4.667	8.074	5.852	4.074	4.074
Cadmium (mg/g)	0.062	0.062	0.062	0.062	0.061	0.061	0.061	0.061
Phosphates(mg/g)	0.012	0.000	0.000	0.000	0.764	0.000	0.420	0.000
Nitrates (mg/g)	0.447	0.263	0.091	0.169	0.513	0.214	0.622	0.273

Conclusions

Based on the results obtained from the measurements exercise, the baseline concentrations of all the parameters tested were below quality criteria stated in (EMCA 2014) regulations.

Recommendations

We highly recommend the proponent to establish proper waste management for the yet to be constructed site. All the transport vehicles should be subjected to pick only segregated waste from the source point. This will allow for proper management at the disposal site. The proponent should adhere to the air quality monitoring schedule as a best practice and to ensure the compliance levels are met as per the regulations

POTENTIAL IMPACTS

A) Construction Phase

Potential primary and secondary impacts from the proposed project on the biological environment have been identified and the significant ecological impact is evaluated based on:

- Size/abundance of habits/organisms affected
- Duration of Impacts
- Habitat Quality
- Species affected
- Magnitude of environmental changes

During this EIA study, impacts were ranked as “minor”, “moderate” or “severe”, although in a few cases a ranking may be minimal. The ranking of a given impact will vary based on the criteria used. For example, an impact might be ranked as “minor” if it affected only common species and habitat, or if it affected small number of individuals or small area, whereas it might be ranked as “severe” if it affected rare species or habitat of large number of individuals or large area.

The sources of activities responsible for the ecological impacts are surface excavations, construction activity, disturbance and damage, site engineering, restoration, dust, litter, etc. This phase has the potential to have the most direct impact in terms of physical loss and disturbance. The disturbance to the flora and fauna may cause due to occupation of land and changes in water levels and flow, landform, etc. damage to the habitat around the site can also be possible resulting from various aspects of normal construction, such as temporary storage of stripped topsoil and bulk access to working areas and incursion of workers into ecologically sensitive areas. Loss of habitat can arise from direct removal of habitat, rearrangement of topography and surface features by grading of an area, or as a result of loss of vegetation. Physical changes to the drainage on a site associated with construction, and installation of new services, can affect drainage of surrounding areas with subsequent effects on habitat damage. The temporary site drainage may cause the local water resources polluted. Flora and fauna may be exposed to the high levels of dust during excavations of landscaping and access roads. The removal of the soil cover will in turn destruct the vegetation and destroy the terrestrial inhabitants. More general disturbance is likely to result from the noise,

dust and movements of vehicles and personnel. The excavation of the landfill could lead to the loss of breeding or nesting sites.

B) Operation Phase

Site formation: The existing land cover and physiognomy support plant species typical of habitats and having a low plant diversity and simple structure. Due to commonness of the species recorded and small area of habitats for herbs and shrubs to be lost, potential impacts to flora are considered minor. During the construction stage; removal of (shrubs and herbs) will reduce the habitat for a few faunal species. It will be temporary and suitable alternatives are available in nearby areas. The proposed peripheral greenbelt will provide a much better habitat for those species than earlier.

Noise, Air Pollution and other Disturbances: Air, noise and visual disturbance may be generated during the site development that can affect the behavior of fauna (especially bird, butterflies and other insects, reptiles and very small mammalian species) of the adjacent habitats. Small mammalian species such as mongoose and palm squirrel were recorded from the site premises. These species will be temporarily affected and may be migrated to nearby areas. However, alternative habitats are available in nearby areas, and disturbance is going to confine to the construction period only. Besides, these activities and the resulting impact on the existing ecology would be suitably compensated and mitigated adopting comprehensive EMP. Hence; the potential impacts to faunal groups from this source are ranked minor.

Traffic and Transport: With the construction of the plant, the traffic in the area is likely to increase, particularly during the construction phase. The increase in traffic may create congestion, potential delays and inconvenience for the residents accessing the localities. This probability of inconvenience faced due to the movement of trucks during construction phase would be negligible, since the trucks would be allowed to transport construction material during night and non-peak hours. Furthermore, the traffic study and Transportation Management Plan being developed for the project would further reduce the negative impact of the traffic increment. Transient Labour population: Labourers for the project would be from Keraraponi and surrounding areas. A maximum of 250 labourers would be working on the site and most of them would be locals. No significant pressure on local infrastructure is envisaged if a small percentage of labourers settle in and around the site during construction phase.

Health: Health impacts are envisaged during the operations phase, particularly the effects of air pollutants on the employees working within the plant and the effects of release of certain polluting components in the localities surrounding the plant. However, inbuilt precautions have been designed for the same. Since adequate measures have been envisaged in the project design, this is unlikely to happen and therefore no likely adverse impact on people's health is predicted. Therefore, the impact significance of the operation stage vis-à-vis public health is very low. Public consultations were conducted in order to inform them about the proposed project. Locals were also communicated about the safety aspects incorporated in the project design.

Noise: The noise levels expected from the planned operating conditions are likely to be within acceptable levels.

Odor: Odor is one of the main concerns of those staying in close vicinity to the plant. Considering this, the design of the facility would be such that the odor will be contained within the boundaries of the facility. Therefore, there is little possibility of odor.

C) Negligible Impacts

Demography: During construction phase, about 250 workers could be deployed. Majority of the labour is likely to be recruited locally and only skilled workers would be from outside, which is anticipated to be very small and will not alter the existing demographic profile of the area. During the operation phase also, the facility would not lead to migration or relocation of any group to the proposed site. A very small fraction of people working in the complex may come and settle near the site. Therefore, the project is not likely to significantly alter the existing demographic profile and the existing population density. Therefore, the impact on demography due to construction and operation of the proposed integrated waste management facility can be considered as "no impact".

Impact on accessing utilities: Utilities include the supply of water, electricity and sewage facilities. Residents in the neighborhood would not face bottlenecks in accessing utility services such water supply, electricity or sewage facilities due to upcoming of the project in the area. Hence, impact on existing utilities due to construction and operation of the proposed waste management facility can be considered as "no impact".

Impact on Historical, Archeological and Architectural Sites: There are no historical or archeological monuments of significance within the study area and hence no negative impact in this regard is anticipated.

CHAPTER SEVEN
PROJECT ALTERNATIVES

7.1 The No Project Alternative

From the discussion with the administration of Kajiado County there were several alternative sites evaluated before they finally settled for Kerarapon sublocation (Embulbul) known as "Vet Farm" to host the proposed solid waste treatment plant. The total surface of the available area is around 140.000 m2. . However possible environmental issues in the proposed site are mainly related to the existence of water springs in the area, which could be contaminated in case of lack of respect for safeguard buffers, or even depleted by excavations, as apparently has happened with other construction works such as the SGR. Other issues are related to the potential contamination of Embakasi (Kibiku) forest. Conflicts on land property and land use: according to interviews and articles on newspapers, a dispute between Kajiado North and Kajiado West Constituencies is ongoing with reference to that area, which is probably subjected as well to phenomena of land grabbing. The County Government affirms that this land is public, so the dispute appears to be connected with its final use. New sites have been proposed by the association of residents of Kerarapon (KEREA), which is interested in maintaining the value of its property (that would probably be decreased in the presence of a new waste treatment facility). Those sites are Oloshoibo and Kimoka. Another site (the quarry located in Embulbul) has also been taken into consideration during the field visit by the team of experts. This site is apparently favoured by some stakeholders, and opposed by others. A public act which forbids the use of the site for waste management was mentioned during the consultative meeting with the community, but unfortunately acquired copy of such document has not been found.

In this sense, an analysis carried out by the advisory team identified some potential weaknesses of the area for the scope of hosting a new waste treatment facility, mainly because of the followings; it is an uncontaminated green area (pristine environment); it is bordering the Kibiku forest; it is very close to a residential settlement (less than 250 m) and it lacks an acceptable access road.

However, the above mentioned issues were analysed and discussed in detail with UN-Habitat and the following facts were also highlighted including; part of Kibiku forest was planted with eucalyptus through an afforestation program and could not be used at obstacle to the project from the environmental point of view; there is already a planned road access to the

area to avoid passing through the forest; the selection of this site was the result of a long and complex decision-making process during which several alternatives were assessed; the identification of an alternative site together with all the administrative works will take years and may delay significantly the implementation of the project and the County of Kajiado also request that the type of technology to be implemented at the site should have minimum or zero impact to the surrounding environment.

CHAPTER EIGHT
ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

Development of an integrated waste management facility falls within Category A project according to world Bank operations, operation policy 4.02 categorization, this implies that negative impacts attributed to commissioning of Ngong' Integrated waste management facility will be mitigated as illustrated in this report's Environmental Management Plan

The following table forms the core of this EMP for the pre-commissioning commissioning and post commissioning. The table should be used as checklist on site, especially during the site closure phase. Compliance with this EMP must be audited daily during the decommissioning phase and quarterly for four years biannually for the next three years and annually during the project lifespan.

Table 19 Environmental Impacts and Mitigation Measures of the proposed Kerarapon facility

PROJECT PHASE	ACTIVITIES	IMPACTS	MITIGATION MEASURES
Pre-construction Investigations The implementation of the project's design and construction phase will start with thorough investigation of the site's biological and physical resources in order to minimize any unforeseen adverse impacts during the project cycle			
1.1 Sourcing and Transportation of Building Materials	Building materials will be transported to the project site from their extraction, manufacture, or storage sites using transport trucks. The building materials to be used in construction of the project will be sourced from Nairobi and neighbouring areas such as Athi River and Juja.		Greater emphasis will be laid on procurement of building materials from within the local area, which will make both economic and environmental sense as it will reduce negative impacts of transportation of the materials to the project site through reduced distance of travel by the materials transport vehicles.
1.2 **Clearance of Vegetation**	The site has vegetation such as grass and mature trees growing in it and other scanty shrubs.	Soil erosion Loss of scenic beauty Loss of vegetation and	The proponent shall ensure as many indigenous trees as possible are used for re-vegetation.

		associated biodiversity	
1.3 Description of the Project's Construction Activities			
1.4 Storage of Materials	Building materials will be stored on site. Bulky materials such as rough stones, ballast, sand and steel will be carefully piled on site.	Waste dumps	To avoid piling large quantities of materials on site, the proponent will order bulky materials such as sand gravel and stones in bits. Materials such as cement, paints and glasses among others will be stored in temporary storage structures, which will be constructed within the project site for this purpose.
1.5 Excavation and Foundation Works	The soil cover in the proposed area is thin and the rocks are exposed to the surface in some areas, with a thin layer of black cotton soil about 4 inches deep.).	Open gapping Landscape alteration	excavated materials shall be and disposed off in approved sites (preferably exhausted quarries
1.6 Masonry, Concrete Work and Related Activities	The construction of the building walls, foundations, floors, pavements, drainage systems, perimeter fence and parking area among other components of the project will involve a lot of masonry work and related activities. General masonry and related activities will include stone shaping, concrete mixing, plastering, slab construction, construction of foundations, and erection of building walls and curing of fresh concrete surfaces.	Elevated noise and vibration	These activities are known to be labour intensive and will be supplemented by machinery such as concrete mixers.
1.7 Structural Steel Works	The building will be reinforced with structural steel for stability. Structural steel works will involve steel cutting, welding and erection	Elevated noise pollution	Use of noise proof materials
	Sheet metal cutting		raising the roofing materials such as clay roofing tiles and

1.8 Roofing and Sheet Metal Works Roofing activities			structural timber to the roof and fastening the roofing materials to the roof
1.9 Electrical Work Electrical work during construction of premises	Installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets etc. In addition, there will be other activities involving the use of electricity such as welding and metal cutting	Elevated noise pollution	Use of noise proof materials
Description of the Project's Operational Activities Number of families will reside within the project site once its construction is complete. Several domestic activities such as cooking, washing, use of vehicles, and leisure and recreational activities will thus a accompany residence. In addition, there will be production of domestic and sanitary wastes.			
2.1 Solid Waste	Solid Waste Generated Large amounts of solid waste will be generated during construction of the project. These will include metal cuttings, rejected materials, surplus materials, surplus oil, excavated materials, paper bags, empty cartons, empty paint and solvent containers, broken glass among others. The proponent will take steps to minimize the generation of such waste and to ensure proper disposal procedures. A lot of domestic waste such as waste from foodstuffs, empty plastic containers, cartons, etc. will be generated during the operational phase of the project	Solid waste generation	The proponent will provide facilities for handling solid waste generated within the facility. These will include dust bins/skips for temporarily holding waste within the premises before final disposal at the designated dumping site
2.2 Waste Water and storm water Management Sewage	generated from each house/unit will be discharged into the existing and proposed septic tanks in the plot and later channeled to the main sewer	Contamination of surface and ground water by leachates	
2.3 General Repairs and Maintenance	The landfill associated facilities will be repaired and maintained regularly during the operational phase of the project. Such activities will include repair of building	Emission of gases Noise pollution	Noise pollution control facilities shall be installed at operation site

	walls and floors, repairs and maintenance of electrical gadgets and equipment, repairs of refrigeration equipment, repairs of leaking water pipes, painting, maintenance of flower gardens and grass lawns, and replacement of worn out materials among others	dust	
Description of the Project's Decommissioning Activities Decommissioning	Is an important phase in the project cycle and comes last to wind up the operational activities of a particular project. It refers to the final disposal of the project and associated materials at the expiry of the project lifespan. If such a stage is reached, the proponent needs to remove all materials resulting from the demolition/ decommissioning from the site The activities will include sand, ballast, hard core, timber, cement, clay tiles, metal sheets, electrical gadgets, and steel, plumbing materials, glass and paints among others. Most of these materials will be obtained locally within Athi River and Nairobi as well as surrounding areas. The main sources of energy that will be required for construction of the project will include mains electricity and fossil fuels (especially diesel). Electricity will be used for welding, metal cutting/grinding and provision of light. Diesel will run material transport vehicles and building equipment/machinery such as bulldozers and concrete mixers	Creation of conducive living and learning environment and habitation of neighbouring schools, churches and communities	. The proponent intends to promote efficient use of building materials and energy through proper planning to reduce economic and environmental costs of construction activities. . The proponent will be responsible for waste management within the housing project and will put in place measures such as provision of waste handling facilities and ensuring prompt and regular waste disposal. On decommissioning, large quantities of solid waste will be generated from demolition works and equipment dismantling. The proponent will provide measures for recycling, reuse or disposal of such wastes.
3.1 Site	Once all the waste resulting from demolition and dismantling works		The following should be undertaken to restore the

Restoration	is removed from the site, the site will be restored through replenishment of the topsoil and re-vegetation using indigenous plant species		environment. • Remove all underground facilities from the site • The site should be well landscaped by flattening the mounds of soil • Planting indigenous trees and flowers • All the equipment should be removed from the site • Fence and signpost unsafe areas until natural stabilization occurs Backfill surface openings if practical Dismantling of Equipment and Fixtures All equipment including electrical installations, furniture partitions, pipe-work and sinks among others will be dismantled and removed from the site on decommissioning of the project. Priority will be given to reuse of this equipment in other projects. This will be achieved through resale of the equipment to other building owners or contractors or donation of this equipment to schools, churches and charitable institutions.
3.2 Building Materials and Energy Used Several building materials will be required for construction of the sanitary landfill and associated facilities			• Energy generated at the facility will power the waste management facility

Table 20 Environmental Monitoring Plan (EMoP) for Kerarapon

Activity/Issue	Action required	Performance/Monitoring	responsibility	Freq	Budget
1.1. Planning	(a) The commissioning must conform to the applicable permit conditions and the minimum requirements associated with the site classification, the (b) development plan and the recommendations of the leachate analysis, hydro geological surveys, soil tests and traffic	(a) Efficiency of compliance to all legislations	KCG	Continuous until end of construction	2,0000000
	(c) The facilities i.e equipment and materials and human resources must be sufficient to ensure that the commissioning of IWMF operations conform to both the closure permit conditions and relevant Minimum requirements	(a) Efficiency of equipment on site and adequacy of materials (b) Numbers of professional staff on site depending on activities and human capacity requirement	KCG	continuous	
	(d) All construction activities within the Kerarapon must be limited to daylight hours. should there be a need to undertake construction at night, written approval will be sought from the NEMA	a) Number of complaints from neighbours b) Number of complaints from the workers	KCG		

	and KCG				
1.2 Appointment of ECO	a) KCG to appoint an independent Environmental control officer (ECO who must monitor the contractor's compliance with the EMoP	ECO employed for the project Monitoring reports	KCG	One off	200,000
	(c) KCG to provide the ECO and contractor and contractor with a copy of the EMoP, design plans and relevant approvals pertaining to the commissioning of this IWMF	ECO qualification in relation to the assignment	KCG	continuous	
	(d) The priority of the CEO is to maintain the integrity of the commissioning conditions outlined in the EMP and must be enforced and adhered to at all time	ECO-outputs deliverables in relation to the EMPs	ECO	continuous	
	(e) The contractor to ensure that the construction crew attend an environmental briefing and training session presented by the ECO prior to commencing activities on site		ECO/contractor	Once off	
Method statement	a) The contractor will submit written method statements to the site manager for the activities identified by the Manager or ECO. Activities that will require method	Monthly reports on activities listed in the method statement	Contractor, RE,ECO	As necessary	500,000

	statements include: (i) concrete pre-cast and batching operation(if applicable) (ii) storage facilities for any hazardous substances (iii) emergency procedures (iv) site establishment (v) removal and clearing of vegetation (vi) materials, equipment and staffing requirements (camp establishment) (vii) transporting the materials and/or equipment to, from and within site (viii) the storage provisions for the materials and/ or equipment (ix) the proposed rehabilitation procedures designed to implement the relevant environmental specifications (x) other information deemed necessary by the residents Engineer and /or ECO				

1.3 Existing services and Infrastructure	a) the contractor shall ensure that the existing services at Kerarapon (e.g. roads, pipelines, power lines and telephone services) are not damaged or disrupted unless required by the contract and with the permission of the RE	Monthly reports on the status of the services before and after project activities implementation	Contractor/ECO/site management	continuous	300,000
	(b) the contractor shall be responsible for the repair and reinstatement of any existing infrastructure that is damaged or services that is disrupted	a) reports of complains b) records of repair and resentments undertaken	contractor	As necessary	
	(c) Repair or reinstatement to be at the contractors cost and shall be prioritized above all other activities	(a) Timely achievement of milestones (b) Lack of interruption of services	contractor	continuous	
	(d) At the time limit for the repairs be stipulated by the site Manager in consultation with the contractor		Contractor, RE,ECO	continuous	
1.4 site boundaries	a) The site boundaries within which the contractor may operate should be agreed to prior to the start of the site operations. The contractor should fence or demarcate these at the very start of the project. Access to the site	a) report cases of trespass through the site b) reported cases of missing items/machinery	Contractor, RE/ECO	continuous	none

	should be restricted to ensure that the members of the public are not able to gain access other than via the designated, controlled access points				
1.6 site layout	a) Specific areas should be set aside within the site for various types of activities. The location of the contractor's camp, sanitary facilities and storage areas should be agreed prior to the commencement of work at the site and should be agreed in conjunction with the ECO, Engineer and contractor. These should all be kept in good condition throughout the project duration to prevent environmental degradation	(a) compliance to site plans ,site out in the design report	Contractor, RE, ECO	continuous	None
Working Hour	Normal working hours will apply as laid in the legislations governing the building industry. These should be agreed prior to the start of the project and should be in line with Kenyan labour; laws	a) number of complaints from the workers working on overtime basis	Contractor, RE,ECO	Continuous	none
Environmental incidents	The contractor must take corrective action to mitigate an incident appropriate to the nature and scale of the incident and must also rehabilitate the residual environmental	Quarterly environmental audits Findings from NEMA inspectors report on the site	Contractor, RE,ECO	Continuous	Total cost of Matrix

	damage caused by the incident or by the mitigation measures themselves				

Activity/Issue	Action required	Performance/Monitoring	responsibility	Freq	Budget
1. Labour recruitment	Contractor shall as much as possible ensure semi- skilled labor from the local community to avoid conflict with residents	Number of semi-skilled labor employed from the community Complaints recorded by locals Compliance levels to labour laws during direct hands on approach. KCG internal policies in terms of recruitment and Kenya labourers must apply Appointed officer			
2. site establishment	Any construction camp required by the contractor must be established in an area as agreed with the ECO. The site for construction camp must not be environmentally sensitive areas such as on a steep slope or on erodible soils. The area must be properly	Location of the camp site Markers in place Signboard on information conveyed	Contractor and RE	Once off	In bidding documents

	demarcated prior to establishment to prevent the construction camp from being unnecessarily large				
3. Leachate management	Discharge of leachate from the IWMF must be properly contained for treatment and disposal The leachate should be analyzed regularly to determine the chemical composing, this will inform the threshold of treatment needed Leachate should never be released into the sewer system, storm drain and the river before proper treatment	Stabilization lagoons in place Treatment and disposal facilities in place Quality of the waste receiving environment e. water quality and other environmental quality status			
4. Methane /hydrogen sulphide and other gas management	Ventilation pipes be fitted with gas traps and flares should be installed	Gas collection system in place Meters installed for monitoring	ECO., KCG	Continual	To be determined after the detailed design
5. General wastes generated during construction phase of IWMF	Clearing of bushes, excavation and cutting should be restricted within the project area All solid waste will be collected at a central	Regular site inspection reports Waste documentation and tracking	Contractor, KCG	continuous	Cost to be determined at detailed design stage

establishment	location at each site and will be stored temporarily until removal to an appropriately permitted landfill site No dumping within the surrounding areas is to be permitted. Where potentially hazardous substances are being disposed of, a chain of custody should be kept with the register as a proof of final disposal Waste generated at the site should be sorted by the contractor and disposed of in a suitable manner into different waste streams. Whenever possible recycling should be carried out Litter generated by the construction crew must be collected in rubbish bins and disposed of weekly at registered waste disposal sites				
6. Liquid waste	The contractor shall ensure that any liquid waste generated during commissioning of IWMF is disposed to a	Undisturbed quality of water resources in the area Regular inspections	ECO ,contractor	continuous	Cost to be determined at detailed design stage

	proper stabilizing lagoon No commissioning liquid waste should be allowed to enter wastewater or natural drainage system Storm water should be to avoid possibility of surface flow entry into the site from adjacent area. Storm water drains in the area should be routinely inspected by the environmental officer for solid wastes to avoid blockages and associated problems	on monthly basis Minimum or no case of pollution			
7. Fire prevention and control from the IWMF operations	All reasonable and precautionary measures to prevent uncontrolled fires at the site due to commissioning activities will be undertaken Accidental fires will be reported to emergency teams, as well control with appropriate equipment located at site and properly documented Ensure that there is basic firefighting	Fire manuals available on site Health and safety awareness among staff Frequency of incidences/fatalities Daily inspections of works Firefighting equipment on site Number of drills and training sessions conducted		continuous	2,000,000.00

	equipment available on site as per requirement of the local emergency services				
8. Erosion control at Kerarapon site	Any construction material s should be screened or covered to prevent off-site movements and surplus material should be removed from site to an approved disposal site Stripping of vegetation should be limited to areas where civil works will be undertaken Berming of open trenches to prevent them from being washed away by run-off	Number of reported cases of flooding within the site Percentage of area exposed	ECO, contractor	continuous	To be include in bid document
9. Dust control	During commissioning , phase windblown dust and sand may generate considerable negative impacts Mitigation measures such as the use of water bowyers and wetting down, as well as the erection of shade netting screens to prevent offsite movement of dust may	Number of complains reported by the neighboring community	CECO, Contractor	continuous	To be include in bid document

	also be required The use of straw stabilization or mulching of exposed sandy areas should also be considered				
10. Storm water management and control	Storm water will be managed according to NEMA and KCG guidelines for erosion control and vegetation management	Number of meters of lined storm water drains Placement of storm water drains within and around the project site Minimum or no ponding of runoff in the area	Contractor	Continuous	Cost to be determined at detailed design stage
11. Emergency procedures	The contractor shall submit method statements covering the procedures and response plan for the main activities, which could generate emergency solutions through accidents or neglect of responsibilities. The situations include, but not limited to: Accidental fires Accidental leaks and spillages Vehicle and plant	Incidences of emergency cases reported in the log book Emergency plans in place Presence of a well-equipped first aid kit Number of staff trained on basic first aid procedures	contractor		

	accidents Blasting Accidental leaks and spillages from IWMF. The contractor shall ensure that his employees are aware of the procedures dealing with spills and leaks. The contractor shall also ensure that the necessary materials and equipment for dealing with the spills and leaks is available on site at all time The contractor shall assemble and clearly list relevant emergency telephone contact numbers for staff and brief staff on the required procedures	Telephone lists of emergency lines displayed on site			

12. Health and safety	The contractor shall comply with all standards and legally required health and safety regulations as promulgated under the occupational Health and safety Act,2007 and associated regulations The contractor must provide and maintain personal protective equipment and facilities to employees working with hazardous chemical substances Official training in the correct fit, use, care, storage and limitation of personal protective clothing respiratory and hearing equipment must be given to the employees The site workers should be trained on basic first aid methods. First aid should be provided on site in case of accidents or minor ailments, aid kit at the site office of each camp/ or additional identified locations	Health and safety awareness among staff Frequency of incidents / accidents and fatalities Health and safety gear for employees Number of employees trained on health and safety Number of reported accidents on site Presence of well-equipped first aid kit	Contractor, RE	daily	Cost to be determined at detailed design stage

	where needed				
13. Air pollution	Un-surfaced roads and temporary roads leading to IWMF must be regularly graded and watered to control dust Active earth work areas ,stock piles and loads of soil being transported must be watered to reduce dust Measure must be taken to immediately mitigate a situation in which excessive fugitive dust is observed. Works being undertaken must be undertaken with caution, or phase down	Number of complaints from neighbor community The service schedule/ reports of machineries/trucks on site Area of vegetated sites Reports and log book entries Site inspections reports	contractor	As when necessary	Cost to be include in bidding document

	while the source is being actively investigated and suppression measures are implemented All areas disturbed during commissioning of the IWMF that are not required for specific activity must be re-vegetated Disturbed soils, slopes and areas of open excavation must be minimized to avoid wind erosion Diesel exhaust emissions from heavy machinery on site must be controlled and minimized by regular checks and servicing of vehicles. Any construction vehicle found to be emitting excessive smoke should be stopped from the operations for some mechanical attention before it could continue				
14. Surface and ground water	The commissioning of IWMF must preferably take place during the dry months. If construction activities	Construction work plans Quantities of sediments present in	KCG, ECO, contractor	Once off, monitor weekly	Cost to be include in the bidding document

	take place in wet months appropriate measures must be taken to control storm water and implemented to prevent erosion Ensure that the excavated and stockpiled soil material is stored and bermed on the higher lying areas Vegetation clearance must be made for sanitation for the construction workers. Septic tanks on site to be emptied promptly when they fill up Construction vehicles are to be maintained in good working order, to reduce the probability of leakage of fuels and lubricants. No servicing of vehicles is to be undertaken in close proximity to watercourses	drainage channels Daily visual inspection of works sites and channels Level of turbidity in receiving water body			
15. Noise and vibration activities	Construction and the use of construction machinery should be limited between 0600hrs and 1800 hr. on weekdays	Lack of complains from the community	Contractor	Monitor daily	Cost to be include in bidding document

	The contractor should use modern equipment, which produces the least noise Any unavoidable noisy equipment should be identified and located in an area where it has least impact. Noise shielding screens should be used and the operation of such machinery restricted to when it actually required Institute noise control measures throughout the commissioning phase for all applicable activities, including the construction times				
16.Aesthetic/Visual	prevent unnecessary removal of vegetation outside the width of working area by clearly demarcating the working area remove spoil material from area once the trench has been filled re-vegetate disturbed ground in the working area by seeding and	Final aesthetic condition of the Kerarapon site	ECO contractor	continual	Cost to be determined during development phase of IWMF

	spreading of vegetation that has been removed from the site				

Table 21 Monitoring indicators

Monitoring Aspects	Parameters	Target Level
Leachate All Monitoring wells	BOD COD TDS TSS Conductivity pH Dissolved Oxygen Nitrates Phosphates ORP Temperature Salinity Colour Heavy Metals e.g Cu, Cd, Mn, Ni, Fe, Pb, Hg Piezometer Levels	Waste water limit levels by NEMA/WHO
Flora	Species composition Density Distribution Ecological attributes	Non Invasive species
Fauna	Species composition Density Distribution Ecological attributes	
Gases	Type of gas Emission volumes	
community		

Socio economic trends	Income levels Income streams Alternative livelihoods established	Use pre-decommissioning state
Health	Type of diseases Prevalence	Compare with general populations and pre-decommissioning levels

CHAPTER TEN
CONCLUSIONS AND RECOMMENDATIONS

Conclusion and Recommendations

The main negative impacts of the implementation of an Integrated Solid Waste Management facility is loss of vegetation as the area will have to be cleared and excavated for construction, soil erosion, atmospheric pollution by dust and smoke emissions from construction machines, disruption of social networks in the area, influx of heavy trucks and machinery in the area increasing noise and vibrations. Increased population along with issues associated with population growth in an area such as constrained resources and competition for social amenities.

The main positive impacts of the facility include improved solid waste management in the county, creation of job opportunities, improved road infrastructure and the project will serve as a model for development of integrated waste management/ sanitary landfill in other counties. Many environmental impacts identified during the construction period are of short term and can be mitigated. Therefore supervision of the project implementation should be of high standard to ensure negative impacts are minimized, reduced and avoided

Positive impacts have long term positive impacts on the development of the area and on the welfare of the people as a whole. The project is expected to promote a clean and healthy environment in the area, promote the economy, and enhance social economic standards of the population in the area and beyond.

SUMMARY OF THE MAJOR NEGATIVE IMPACTS AND MITIGATIONS FOR DEVELOPMENT OF INTEGRATED WASTE MANAGEMENT FACLTY AT KERARAPON, NGONG'

a) Loss of sources of livelihood

Project affected persons will lose their main source of livelihood

Recommended mitigation measures include;

- Compensation for the persons affected by the project
- Employment in the transfer stations at Kerarapon
- Construction of kiosks for small and medium enterprises for the project affected persons

a) Disruption of social networks

The project affected persons have already developed social networks which will be broken on decommissioning of the dumpsite

Recommended mitigation measures are;

- Foster the retention of the social groups by engaging in similar activities
- Develop activities that youth will engage in such as environmental conservation, sports and arts

b) Water pollution

During excavation and compacting there will be a possibility of leachate discharge to the river

Recommended mitigation measures include

- Appropriate storm drains to be constructed to drain the leachate
- Identify sites containing high volume of leachate

c) Gaseous Emissions

During construction phase, there will be gases emitted from the facility

Recommended mitigation measures include;

- Flaring of the gases
- Construction of vents

d) Loss of vegetation

Vegetation will be cleared to give way for the ISWM establishment

Recommended mitigation measures include;

- Minimize destruction of biodiversity
- Identify sites with rare vegetation that may require protection
- Embark on planting trees and grassing and care for the same during construction

e) Excavation and soil erosion

The excavations on the site will result on storm water flowing increase due to paving and changed natural flow patterns. This will include erosion may cause gulling

Recommended mitigation measures;

- Provision of channels and anti-scour pads especially in steep slopes
- Plant grass and trees along verges and embankments
- Dispose of the storm water at frequent intervals
- Control earthworks
- Dispose of excess excavated soil appropriately
- Use excess soil to recondition material sites

Socio Economic impacts and Mitigation measure

Socio Economic Impact assessment was done between 18th and 25th, April, 2018 to estimate changes ranging from socio-economic and cultural consequences of the proposed development of Integrated Waste Management facility. These included.

a) Education patterns within people living in the area

b) Health related issues

c) Occupation

d) Water and sanitation

e) Household expenditure

f) Loss of shelter

g) Breakdown of economic generating activities

h) Loss of shelter

The prediction in social changes is important in shaping the design of the project to minimize negative impacts to the social environment while maximising on positive impacts of the project

Social Impacts

The social impacts of the proposed project include;

i) Loss of livelihood of the people scavenging at Ngong' dumpsite. From baseline socio- economic survey it was noted that most of the population depend solely on the above named economic activities, therefore commissioning of the IWMF will destroy sources of income activities.

j) Loss of social relationship

k) Loss of shelter to people living within the Kerarapon/Vet farm

(a) Mitigation measures

In order to mitigate these factors the project implementation agency will have;

a) Prior to commissioning of the ISWM facility all PAPs should be properly resettled and alternative income generation activities for waste pickers in the old dumpsite sought

b) After commissioning, consider the option of employment for the job seekers.

c) Develop alternative housing facilities for PAPs within the Kerarapon site

d) Facilitate the identification and subsequent relocation sites for the parts of the population such as the old and unemployed form the old dumpsite

e) Assure the community that is currently grazing at the site of compensation through disclosure in public barazas (gatherings) on how compensation process will be handled

f) Develop a credit scheme to offer loans to population living within the project area and link them to micro finance institutions

g) Provision of transport for the portion of the community that will need to be resettled.

h) Kajiado County should develop a programme to educate the population on the ISWM approach.

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Annex I: Public involvement Summary (Main issues focused)

Location of the New Facility

The County Government has proposed an area located in Kerarapon sub-location (Embulbul) known as "Vet Farm". At the present, the area is accessible only though a road which goes across the surrounding forest. During interviews, many concerns have been raised by several stakeholders:

Environmental issues are mainly related to the existence of water springs in the area, which could be contaminated in case of lack of respect for safeguard buffers, or even depleted by excavations, as apparently has happened with other construction works (S.G.A.). Other issues are related to the contamination of Embakasi (Kibiku) forest.

Conflicts on land property and land use: according to interviews and articles on newspapers, a dispute between Kajiado North and Kajiado West Constituencies is in act on the land in object, which is probably subjected as well to phenomena of land grabbing. The County Government affirms that this land is public, so the dispute appears to be connected with its final use.

New sites have been proposed by the association of resident of Kerarapon (KEREA), which is interested in maintaining the value of its property (probably depleted in presence of a treatment/disposal site). Those sites are: Oloshoibo; Kimoka.

Another site (the quarry located in Embulbul) has been identified by the PoliMI team. This site is apparently favored by some stakeholders, and opposed by others. A public act which forbids the use of the quarry for waste management has been mentioned, and it should be acquired

Therefore, the project should deal with following aspects:

The new facility should employ local people.

The job should be ensured for people currently working in the dumpsite.

People living in the dumpsite of Ngong' should be provided with alternative solutions.

Annex 2: Geotechnical Survey Report

PROPOSED DEVELOPMENT KAJIADO KISWMF
Geotechnical Investigations Preliminary Report
September 2018

Date 13th September, 2018
Geoconsult Africa ltd,
P.O. Box 15766 00100, Nairobi – Kenya,
3rd floor, Professional Centre, Kiambu Rd,
Email: info@geoconsultafrica.com
Tel: +254724291042.
Proposed Development,
Kajiado Integrated Sustainable Waste Management Facility
Dear Sir,

Geotechnical Site Investigation Preliminary Report

We hereby submit our preliminary soil investigation Report on the Geotechnical investigation carried out on a site that has been proposed for development.
Our submission is in accordance with your instructions, drilling of boreholes for geotechnical investigations and subsequent laboratory materials testing and analysis currently ongoing.
We do hope you find this useful for your process execution.
We remain,
Yours Sincerely,
Geoconsult Africa Ltd

PROPOSED DEVELOPMENT ON LR NO. KABETE/KIBICHIKU/2634 GEOTECHNICAL INVESTIGATIONS

1.0 INTRODUCTION

This preliminary report presents field work results of geotechnical investigation carried out on a site that has been proposed for development
The Purpose of the investigation was to gather subsurface data at the site to facilitate in the preliminary evaluation of the suitability of the site.
The work involved the following:

i. Drilling of three (2) number boreholes at the site as identified by the client
Carrying out In-situ testing including standard penetration test (SPT) and undisturbed U100 sampling where feasible.

ii. Geological Logging of the strata encountered in the borehole including monitoring of the sub surface water regime where it's encountered.
All the fieldwork was carried out according to BS 5930 (code of practice for site investigations). The laboratory testing was done in accordance with British Standards (BS 1377-7) and the American Society for Testing Materials (ASTM) designated D- 2938-79. Brief details of the onsite works, laboratory tests and analysis are given in the following sections of this report together with comments relating to design and construction practice.

2.0 SITE AND GENERAL GEOLOGY OF THE AREA

The general geology of Ngong and the surrounding area comprises of Tertiary volcanic which overly the Archean basement rocks. The Tertiary volcanics encountered are associated with the formation of the rift valley system. It is in the age of Pliocene to Miocene which is the most active period of rift faulting where extrusion of volcanic rocks took place forming the present day various volcanic layers.
The underlying basement system is part of the metamorphic Mozambique Belt that stretches from Mozambique in the south through Tanzania, Kenya and into Ethiopia to the North. The general stratigraphy of Ngong area can be classified as follows;

- Soils of recent age
- Upper Athi Tuffs
- Ngong Basalts
- Kapiti Phonolite
- Basement System

Upper Athi Tuffs

These are a group of tuffs and ashes laid down by explosive volcanic activity during the period of formation of Ngong hills. It is inferred that they were laid down in water from the observed stratification. These tuffs are light grey when fresh and yellowish when weathered. Compact tuffs, agglomerates and trachytes are the basic rock types forming the major group.

Geology of the project area comprises of light grey moderately weathered tuffs which are underlain by dark brown, moderately weathered and highly vesicular basalts. These basalts, commonly known as Ngong basalts, are highly responsible in the control of natural groundwater flow of the area in general.

Field work

The field work involved rotary drilling of two boreholes to the required depths of maximum 40 meters below ground level.

Ground Water

The boreholes were observed while drilling and immediately after completion for the presence and level of groundwater. The observations are summarized below;

FIELD FINDINGS

The site is comporised of a thick layer of red soils to depth of nine meters in Bh1 and 12 meters in Bh 2.

The red soils overlay a layer of weathered volcanic rocks that transition to vesicular basalts to the termination of the boreholes.

No ground water was encountered during field work however we observed that the vesiclura basalts have the potential to hold water especially during periods of extended rainfall.

The strength of the site material is considered high making the site suitable for structural buildings with high bearing capacity.

There is abundant soft material for use at site highly suitable for use in waste treatment facility.

The site is suitable for the proposed project

Drill Hole Depth to groundwater while drilling

1 Not encountered

2 Not encountered

APPENDIX 3

LABORATORY TEST RESULTS

The tests are currently underway. The results will be shared soon

DISCLAIMER

This report presents exclusively the test results and analyses carried out on samples recovered from the above mentioned site alone and it shall not be reproduced, in part or in full, without the written consent of Geoconsult Africa Limited

Annex 3: Topographical Survey

TOPOGRAPHICAL SURVEY OF PROPOSED NGONG' GARBAGE MANAGEMENT SITE

1. Introduction

In general, surveying is performed to determine the relative location or positioning of points on or near the earth's surface. More specifically, surveying is the science of making measurements, relative to known or assumed datums and standards; and applying the principles of mathematics to such measurements to determine the horizontal and vertical positions features. Surveying encompasses different categories such as ground topography, land survey, aerial photography and LiDAR survey, etc. To represent the topography of an area of interest, a topographical map that gives a graphical representation of the existing features is required. The ground topographic survey is essential in the establishment of the exact location of features.

In this regard, the Technical University of Kenya in collaboration with the County Government of Kajiado undertook a topographical mapping exercise of the proposed garbage management site. The purpose of this exercise was to determine the approximate area and elevation of the proposed site and generation of a topographical map of the site showing the existing ground features. Modern, sophisticated equipment such as differential GPS equipment and UAV was used to achieve this exercise.

2. Field Survey Methodology

The methodology for undertaking the assignment was based on the overall scope of the assignment, which is to "Generation of Topographical map of the Topographical Survey of Proposed Ngong' Garbage Management Site."

2.1 Reconnaissance

Reconnaissance was conducted to familiarise with the working environment, get to know the locals and to identify the existing control points within site.

2.2 Equipment

The instruments used were:

- Three CHC GPS sets (receivers) for static and RTK observations.
- DJI Phantom 4 Pro for aerial imagery acquisition.

The following software packages were used in the analysis:

- HGO for processing of the GPS data.
- PIX4D for processing UAV Aerial Images
- Global Mapper for terrain analysis
- ArcGIS for generation of Topographical Map.

2.2 Existing boundary points of the proposed site

The provisional coordinates (Arc 1960, UTM Projection) of the boundary defining the proposed site were as follows;

Point	Northing	Easting
Pds1	9853875	238355
Pds2	9853276	237904
Pds3	9853363	237869
Pds4	9853708	238006
Pds5	9853708	238048
Pds6	9853757	238125
Pds7	9853795	238125
Pds8	9853855	238255

The existing control point **(Pds1)**, which is a boundary corner point of the site was used as a reference station for controlling the topographical survey of the site. Since the control point **(Pds1)** did not have a height, an arbitrary value of 1980 was assigned to it. Since other points defining the boundary were not existing, observations were made where new boundary points were resurveyed using GPS receiver in differential GPS in RTK mode.

2.4 Provision of ground controls for aerial survey.

Temporary Ground control points (GCPs) were established using Real Time Kinematic mode (RTK). Temporary targets were used as ground photo control. The coordinates for these targets were obtained by the use of differential GPS in RTK mode. These control points were established for georeferencing, optimisation of camera locations and generation of the DEM.

2.5 Aerial Image Acquisition

DJI Phantom 4 professional; a rotary wing quadcopter UAV was used for the image data acquisition. The UAV was equipped with 20 megapixels, focal length of 2.8mm, and 4K resolution DJI FC300X camera. The camera has RGB band and operates in both manual and auto mode. To ensure a smooth and a safe flight mission, a pre-flight test was carried out to ascertain that every part of the UAV system functioned properly. A flight plan for the area was designed to ensure total coverage of the entire imaging area and at the desired percentage overlap. The UAV flew automatically capturing the images at the designed overlap. The images were downloaded and processed in a PIX4D photogrammetric software. The results obtained were 4 cm resolution ortho-mosaic and 5cm DEM.

2.6 Projection

Map Projection	Universal Transverse Mercator(UTM) Zone,37S
Spheroid	Clarke 1880
Unit of measurement	Meter
Latitude of origin	0^0 (Equator)
Scale factor at the origin	0.9996
False Easting	500,000M
False Northing	10,000M
Datum	Arc 1960

3 Results

3.1 Coordinates of the proposed site

	Proposed Coordinates		**New Surveyed Coordinates**	
Point	Northing	Easting	Northing	Easting
Pds1	9853875	238355	9853875	238355
Pds2	9853276	238110	9853276.387	238117.599
Pds3	9853363	237904	9853359.447	237911.465

Pds4	9853494	237869	9853498.087	237874.52
Pds5	9853708	238006	9853699.907	238012.098
Pds6	9853757	238048	9853752.042	238055.412
Pds7	9853795	238125	9853789.872	238120.721
Pds8	9853855	238255	9853846.401	238243.425

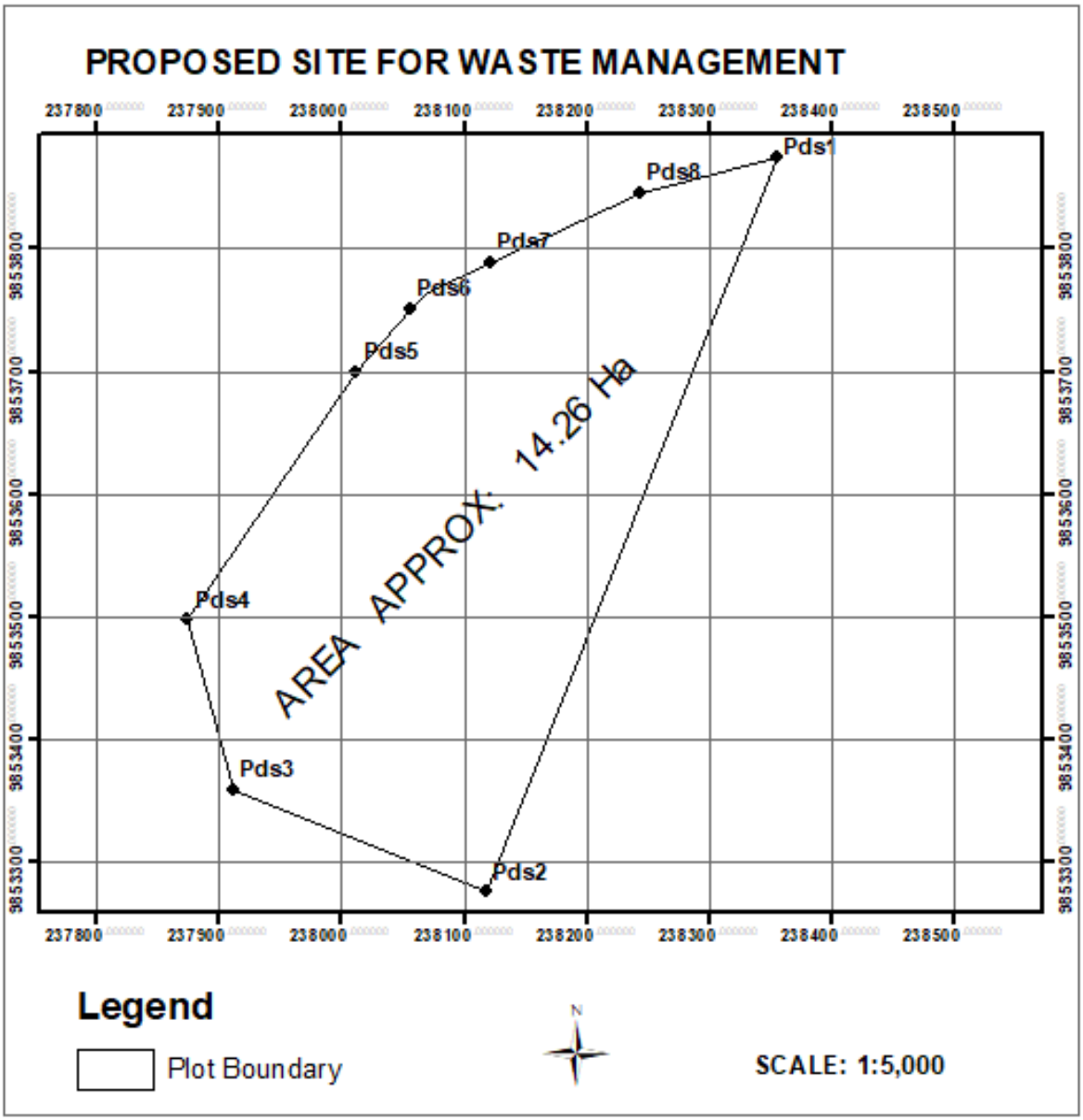

Figure 2: Proposed Site

The proposed site is approximately **14.26 ha**. The site is an open place characterized with grass and is surrounded by a forest to the southern, western and Northern parts and is bordered by Vet Farm to the eastern part. Four apartments are located at the end of the site at the northern part. The road to the site is through the forest. The position of the existing features is represented in the attached topographical map (See fig 1).

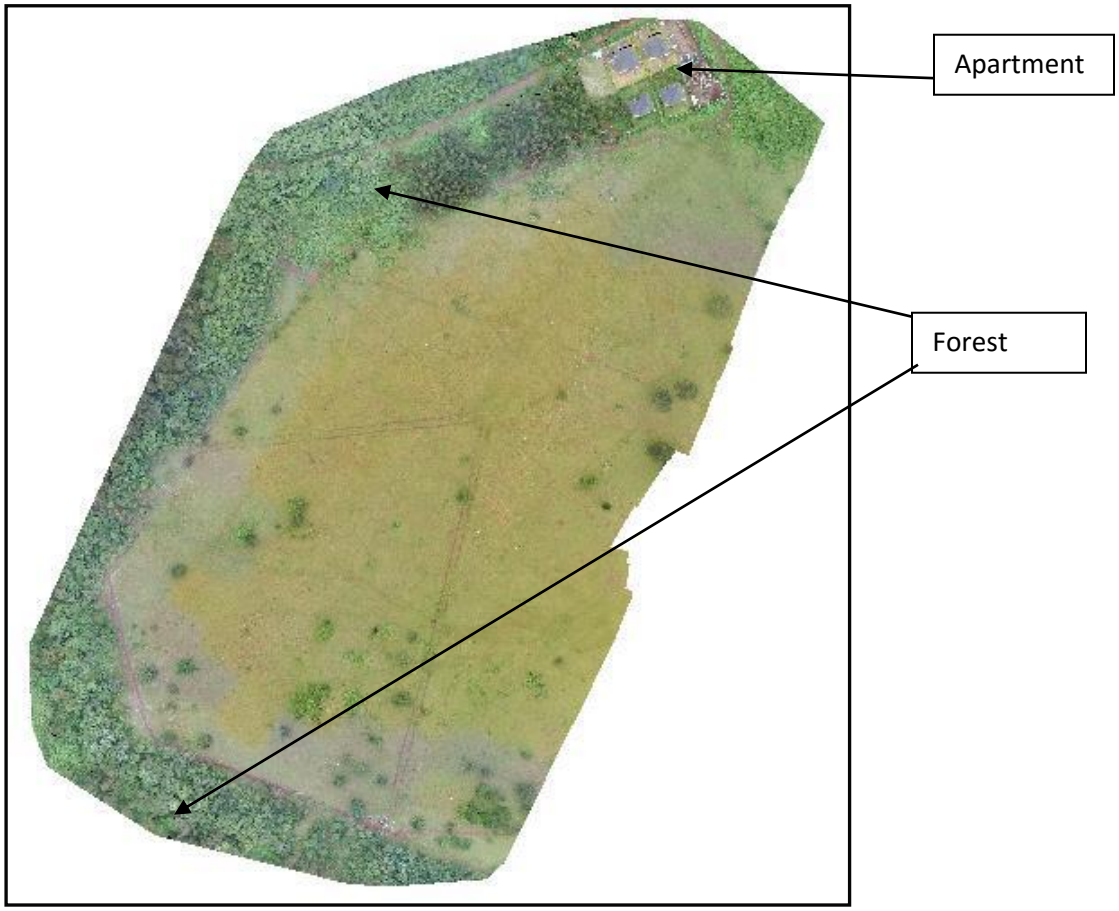

Figure 3: Orthomosaic Image of the Site

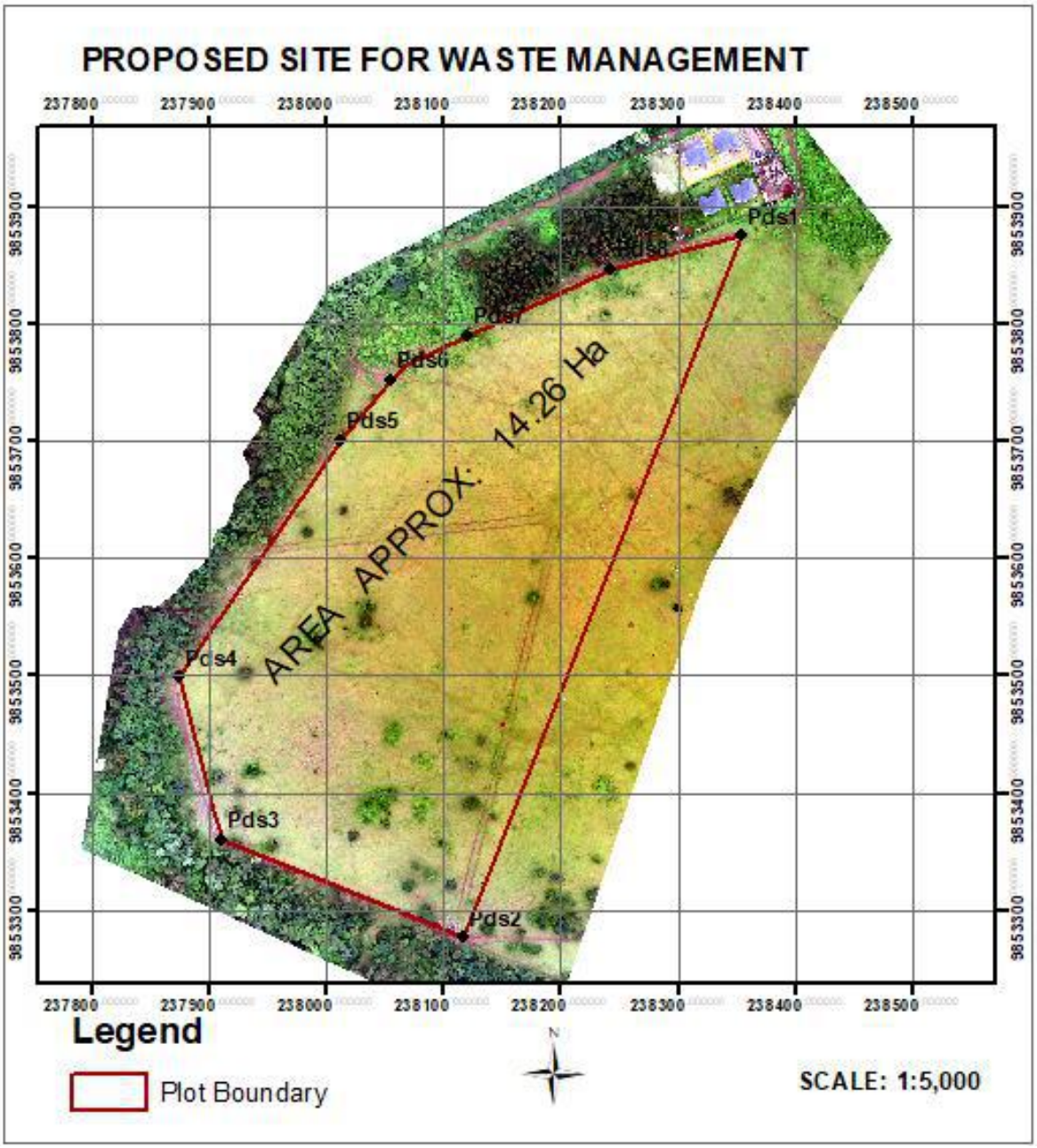

Figure 4: Proposed Site

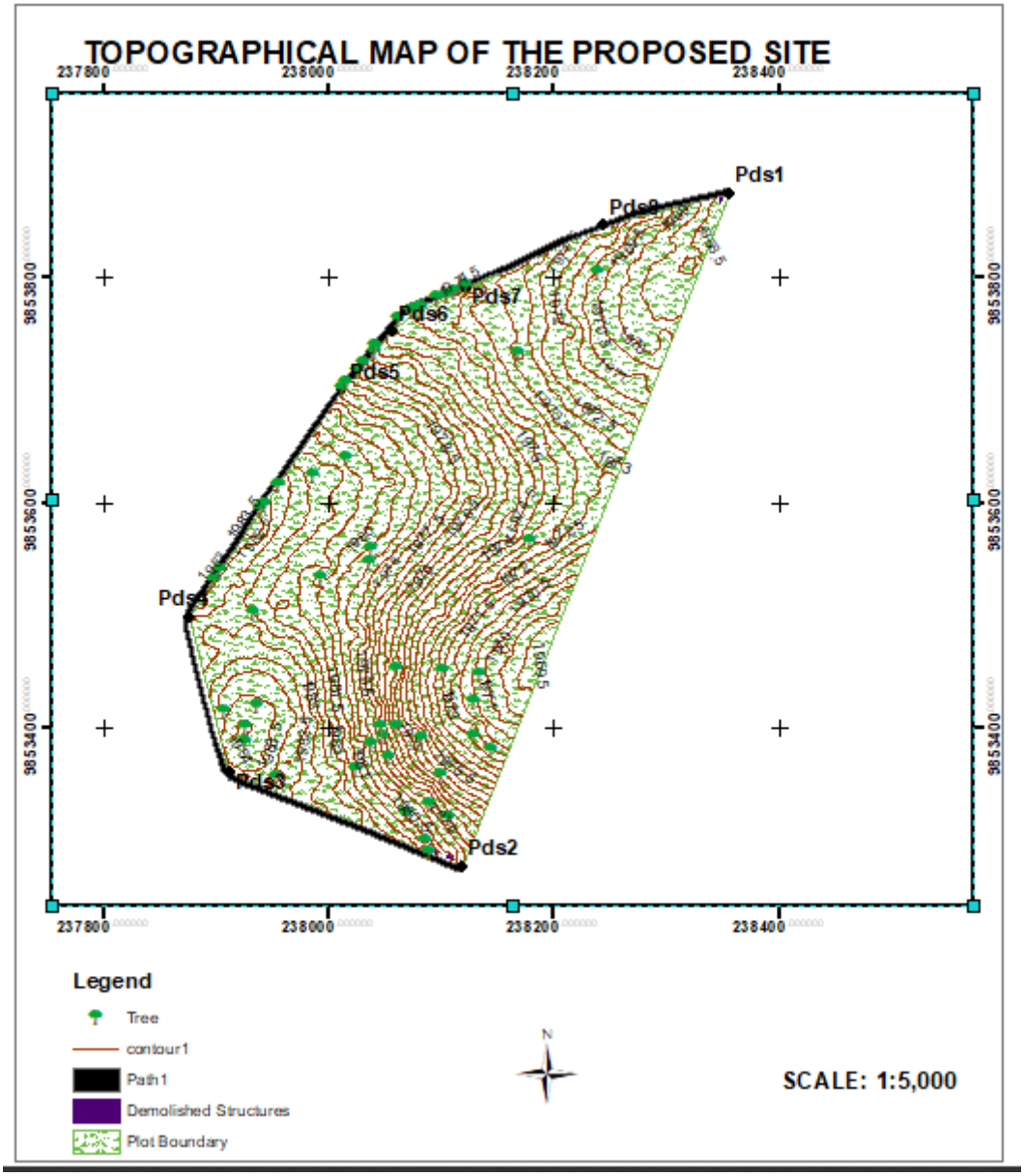

Figure 5: Topographical Map of Proposed Site

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Annex 4: Stakeholders validation Workshop

UN HABITAT

Comprehensive feasibility study for the closure of the informal dumpsite and construction of an integrated sustainable waste management facility for Kajiado County

Validation Workshop

13September 2018

1.0 Background

The lack of proper waste management systems in Kenyan towns and cities has led to the proliferation of informal, unsanitary dumpsites such as the one located in Ngong town. A partnership involving the Italian Government, the Kenyan Government and the Kajiado County Government is seeking to provide a long lasting solution to improper waste management and also to create a pilot project in Kajiado that could be successfully replicated in other towns in Kenya.The proposed solution to improve waste management in Kajiado will see the construction of a new Integrated Sustainable Waste Management Facility (ISWM) that will convert the waste to energy. The project has successfully completed the feasibility study carried out by a consortium led by the Politecnico di Milano (POLIMI). Other consortium partners were the Technical University of Kenya (TUK) and LDK Consultant Engineers and Planners.

The feasibility study had two objectives which were;

1) To conduct a comprehensive feasibility study for the closure of the current dumpsite; and

2) To conduct a comprehensive feasibility study for the design of the new Kajiado Integrated Sustainable Waste Management (KISWAM) facility.

The feasibility study overseen by UN-Habitat covered both social and environmental impact assessments.

A project inception workshop was held on the 2nd of February 2018. The validation workshop follows the completion of the activities conducted during the feasibility study and was organized by UN-Habitat in partnership with the Kajiado County Government. The workshop was held at the KCB Leadership Centre. It was attended by His Excellency Joseph ole Lenku, the Governor for Kajiado County, Members of Parliament from 2 constituencies in Kajiado, members of the County Assembly of Kajiado, officials from the County Government and other major stakeholders including representatives from the National Treasury, the Ministry of Ministry of Environment and Natural Resources, the Italian Agency for Development Cooperation, the National Environment Management Authority (NEMA), local residents, local politicians, private waste collectors and workers at the current dumpsite in Ngong..

2.0 Workshop Objectives and Expected Accomplishments

The main objective of the workshop is to bring together the various stakeholders in order to enable the implementing partners POLIMI, LDK, TUK and UN-Habitat to present the results of feasibility study.

Its specific objectives included:

- To allow the implementing partners to share the results of the feasibility study with stakeholders;
- To allow input and feedback from stakeholders;
- To allow the implementing partners and all the other stakeholders to discuss the way forward as the project moves into the implementation stage which will see the closure of the dumpsite and the commissioning of the new facility.

The validation workshop had the following expected accomplishments;

- Enable all the stakeholders to understand the activities undertaken during the feasibility study; and
- Enable all the stakeholders to understand the next steps in the implementation of the full project.

3.0 Introductions

3.1 Kajiado County Government Department of Environment and Natural Resources

The workshop formally commenced with introductions from the participants and welcoming remarks from James Sankale the Chief Officer in the Department of Environment and Natural Resources in the Kajiado County Government. Mr. Sankale thanked all the participants for making time to attend the workshop. Heexplained the importance of working in partnership to ensuring that the project to close the dumpsite that has become a menace and commission the new facility is to be successful. He reiterated that the project had the blessing and support of both the National and County Governments. Mr. Sankale highlighted the importance of public participation I the project revealing that County officials would visit all the wards in Kajiado to publicize the project and raise awareness on the importance of modern waste management. Including the public as active participants will increase waste collection services and ensure the viability and sustainability of the new waste management system.

Mr. Sankale called for greater involvement of local tertiary and vocational institutions. These could partner with TUK and other project implementing partners to acquire new training and skills. He added that the involvement of youth and women will allow them to benefit from job and enterprise opportunities and called for the prioritization of homemade solutions during the implementation of the full project to ensure sustainability and the ready availability of appropriate solutions to any challenges that may arise.

3.2 Kenya Government Ministry of Environment and Forestry

Engineer Lawrence Simitu is the new Cabinet Secretary in the national Ministry of Environment and Forestry. He thanked all the participants for attending the workshop and thanked the Italian Government for their support. The Cabinet Secretary said that his ministry which has only recently been formed is following the progress of the project with interest. The project has the support of the ministry which is a national priority. The best way to process waste is to turn it into a resource. This will enable the urban areas of Kenya to emulate other cities around the

world where waste is no longer a challenge. The project will be a pilot for replication in other counties that face challenges associated with waste management.

3.3 Italian Agency for Development Cooperation

Giuseppe Caposeno from the Italian Agency for Development Cooperation represented the Director of the Agency who was unable to attend the workshop due to other commitments.

Mr Caposeno said that waste management is not an easy topic to handle as it involves a lot of technical and management skills as well as changes in lifestyle. These changes will enable waste to be managed as an asset.

He stressed the importance of modern waste management which is highlighted by its linkages to the sustainable development goals (SDGs) and reiterated the support of the Government of Italy for the successful implementation of the project.

3.4 Speech from the Executive Director of UN-Habitat

The UN-Habitat Executive Director's speech was delivered in her absence by Dr Vincent Kitio the Chief of the agency's Urban Energy Unit. In her remarks, the Executive Director welcomed all the workshop participants and thanked the Kenyan Government, the Kajiado County Government, the Italian Government and the Italian Agency for Development Cooperation, the consortium led by POLIMI as well the project's National Steering Committee for their important

roles in the funding and successful completion of the project's feasibility study. She revealed that UN-Habitat is interested in the project for reasons which include improvement of the living conditions of the population of Kajiado County; the project's intention to design a waste management system that responds to the principle of sustainability, while remaining environmentally friendly, socially acceptable and economically viable; and the development of a modern waste management model that will be replicated by other cities and towns in developing countries.

She revealed that the findings of the feasibility study show that the project will indeed be feasible with a good share of the waste being recycled. The resource recovery facilities and landfill site will serve to improve the current improper handling of waste and benefit local communities by turning recyclables into items of value. She also stated that the KISWAM project should be implemented through a participatory process that will involve all stakeholders and be informed by best practices from around the world.

3.5 Remarks from the Governor of Kajiado County

The Governor of Kajiado County His Excellency Joseph Ole Lenku welcomed the workshop participants and stated that the KISWAM project has been at the top of his development agenda since he came into office in 2017. The project has his full support and the support of his entire cabinet as they would like to see the informal dumpsite closed as soon as possible.

The commissioning of the KISWAM facility following the closure of the dumpsite will improve living conditions in the county. He gave assurance of his political goodwill and reiterated that the presence of all the leaders from Kajiado North including the MPs from Kajiado North where the dumpsite is located and Kajiado West underlines the overwhelming desire to see the menace of the dumpsite eliminated. Once the feasibility studies have confirmed that there will be no negative environmental and social effects in commissioning the new facility, the project should commence immediately. The people of Kajiado feel the same after suffering for a long

time from the lack of modern waste management services. The Governor concluded by affirming his support for the project and all of its activities.

4.0New Technology for Material and Energy Recovery from Waste

The report on the technology for the KISWAM facility was presented by Engineer Claudio Del of POLIMI. He told the workshop that waste composition played a key role in the identification of the appropriate technology to be used in the KISWAM facility. In Kajiado County, organic waste is the most relevant fraction with food waste accounting for about 70% in weight. The technologies considered for Kajiado included the use of a sanitary landfill and the use of a biodrying unit combined with a bioreactor. After considering the merits of these technologies, the latter alternative was found to represent the most suitable for Kajiado County. The technology works well with a wide range of waste.

The technology has also been recommended because it allows the separation of mixed waste manually in hygienic conditions, minimizes the odour and the related social impacts, it represents a flexible solution that will also be suitable for future source-separated waste, when a proper separate collection system will have been put in place. The system's capital cost is also affordable compared to the other options and it is a robust technology that does not require complex high-tech equipment and skills. The feasibility study has recommended that the KISWAM facility provides formal employment opportunities for the waste pickers

currently working at the dumpsite. They will benefit from the new safer, sanitized conditions.Solar PV will be installed on the facility's rooftops to generate electricity to be used in daily operations. Excess electricity will be sold to the grid providing an additional income stream. The cost of constructing and operating the new facility was also presented to participants.

5.0Dumpsite Close and Rehabilitation

LDK Consultants were responsible for the design of the approach to be used in the closure and subsequent rehabilitation of the dumpsite. Constantinos Nicolopoulos representing LDK revealed that the severity of the threat to both the community and the environment makes it imperative to close the dumpsite immediately.

Closing the dumpsite will involve engineering works including; the leveling and compacting of waste; construction of top cover layers; storm water drainage works; leachate management works; installation of a biogas management system; improvement of the access road; installation of a monitoring system; and other pertinent auxiliary works.

The rehabilitation of the dumpsite is necessary in order to; reduce the effects of pollution on the soil, groundwater and surface water caused by the flow of leachate; manage biogas emissions; and eliminate windblown litter and visual blight nuisance from uncovered waste.

The dumpsite will be closed once the temporary facility known as the Integrated Resource Recovery Centre (IRRC) to be constructed at the site of the integrated solid waste management

facility is ready for use. The workshop was shown examples of dumpsites and landfill sites that have been successfully rehabilitated. Vegetation can be successfully grown on the rehabilitated surface and the old dumpsite can be turned into useful spaces that benefit local communities such as public parks and golf courses.

6.0 Transitional Phase: Integrated Resource Recovery Centre

This section was presented by Dr Vincent Kitio of UN-Habitat who informed participants that before the closure of the dumpsite can be effected, an alternative will have to be found. The recommendation is for the construction of a transitional waste treatment known as an Integrated Resource Recovery Centre (IRRC) on the same site as the proposed KISWAM facility.The IRRC will be used to manage all municipal waste while the KISWAM facility is under construction. It will be constructed according to recognized international standards in order to provide sufficient space for waste treatment (sorting and landfilling under controlled conditions) until KISWAM commences operations.

The IRRC will contain a sorting facility, a waste processing plant in the form of a plastic shredder, a sanitary landfill including biogas collection system and a service building. The costs of constructing and operating the IRRC including the cost of human resource was provided.

Also presented to the workshop was the income that the IRRC can bring in based on the sales of recyclable materials, compost and electricity from biogas as well as carbon credits. Initial calculations show that the facility would have a positive net worth with the income exceeding the expenditures.

7.0 Environmental and Social Impact Assessment Report

This section was presented by Dr Lewis Sitoki of TUK who told the participants that the Environmental and Social Impact Assessment was conducted to; ensure that all environmental consequences due to the Ngong' dumpsite in its current state are evaluated and analyzed and mitigated; ensure that the environmental and socio-economic impacts evaluated and addressed as part of the mitigation measures incorporated into the new facilities' final design; and to ensure that the project is environmentally friendly, socially acceptable and economically viable.

Parameters such as air quality, water quality soil quantity and the impact on fauna and flora around the dumpsite and its surroundings were monitored. The level of contamination was found to be in excess of the minimums stipulated by the World Health Organization. The ESIA concluded that closing the dumpsite will lead to long term positive impacts including improved health of the population through reduced cases of respiratory and water borne diseases, improved water quality in Ngong river and other surface streams and reduced pollution to downstream ecosystems.

The long term negative impacts of closing the dumpsite were reported to be the loss of dumpsite linked livelihoods, the emission of gases and the disruption of the existing social networks. More than 80% of respondents interviewed during the ESIA indicated that the

dumpsite should be completely relocated. TUK therefore highly recommended the closure of the dumpsite and the subsequent commissioning of a modern facility in its place.

8.0 Results of the Geotechnical Survey

Presented by James Munene of Geoconsult Africa Limited. The firm was responsible for carrying out the geotechnical investigation at the proposed site for the KISWAM facility. The survey involved the drilling of two boreholes of 25 metres depth each at the site in order to investigate soil consistency and structure as well as the groundwater levels.

The full report following the investigation is being finalized but Mr. Munene reported that initial results indicate that the new site is ideal for the propose facility. The facility's foundations will not affect the water table which was located at a depth of 14 metres or below.

9.0 Afternoon Session

Godfrey Wafula the Director of NEMA in Kajiado County confirmed that the project complies with environmental law and that the ESIA once completed will lead to the approval of plans for the new facility as well as the closure of the illegal dumpsite. Mr. Wafula stated that once the closure of the dumpsite begins NEMA will play a leading role in ensuring that the goals of environmental compliance are met and will issue the necessary licenses.

Members of the County Assembly present reiterated their support for the project and revealed that they are already in the process of developing environmental and solid waste policy. Once these are passed, they will provide the frameworks necessary to implement the project and ensure its sustainability. Kajiado County Assembly will also take part in the awareness raising and public consultation activities to catalyze public participation and support for the project.

The workshop was closed by Florence Waiganjo the County Executive Committee Member in charge of the ministry of Water, Energy, Environment and Natural Resources.

The Minister thanked the participants for their attendance and also thanked the implementing partners, the Italian Government, the National Treasury, UN-Habitat, NEMA, the Ministry for Environment and Forestry and Kajiado residents. She urged the Project Steering committee to speed up the process of implementing the project as it will safeguard the health of the public in Kajiado County. She added that the project also had other advantages including the creation of employment for youth who would otherwise be idle and unemployed before declaring the workshop officially closed.

Photo Album


WASTE TO PRODUCT


WASTE TO PRODUCT
& YOUTH EMPOWERMENT


WASTE TO PRODUCT

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