ENVIRONMENTAL IMPACT ASSESSMENT (ESIA) STUDY REPORT FOR

THE PROPOSED QUARRY, CRUSHER, CONCRETE BATCHING PLANT, ASPHALT MIXING PLANT AND OTHER SUPPORT FACILITIES ON NINE PARCELS OF LAND THAT HAVE BEEN LEASED FROM NINE FAMILIES, RIAMUGAA VILLAGE, KIBINGOTI SUB LOCATION, KIINE LOCATION, KIRINYAGA COUNTY

TO FACILITATE THE DUALLING OF SAGANA-MARUA (A2) ROAD PROJECT

GPS CO-ORDINATES

Latitude -0.587866 & Longitude 37.203170

PROPONENT

CHINA WU YI COMPANY LTD
P.O. BOX 49282-00100
NAIROBI

CONSULTANT

RICLA ENVIRONCARE CONSULTANCY- NEMA REG. NO. 6605
0720400257
EMAIL: envirocare.consultancy@gmail.com /info@ricla.co.ke

MARCH, 2021

DECLARATION

This Environmental Impact Assessment (ESIA) Study Report has been prepared in accordance with NEMA regulations under the guidance and supervision of registered NEMA Lead Experts. It meets statutory provisions stipulated in EMCA 1999.Revised 2015 and the Environmental Impact Assessment and Audit Regulations 2003 revised 2019. We hereby certify that the details herein are correct and true to the best of my knowledge.

FIRM OF EXPERTS: RICLA ENVIRONCARE CONSULTANCY
NEMA REG. NO. 6605

LEAD EXPERT: CLAMSON ONDIEKI OGUTU

NEMA REG. NO. 0524

Signature: …… Date……

PROJECT PROPONENT

CHINA WU YI CO. LTD
P.O. BOX 49282-00100
NAIROBI

NAME ……DESIGNATION ……

SIGNATURE: …… Date……

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EXECUTIVE SUMMARY

The proponent (China Wu Yi Company Ltd) has been awarded a contract by the Kenya National Highways Authority (KENHA) to undertake the dualling of Sagana-Marua A2 Road project. In order to carry out the road construction works efficiently, the proponent identified an area that is approximately one Kilometer from the Sagana-Marua road in Riamugaa Village, Kibingoti sub location, Kiine Location that was found to have the right geological soil/rocks for the rock- quarry. The proponent also leased other parcels of land adjacent to the proposed quarry site for setting up of a crusher, concrete batching plant an asphalt mixing plant and support facilities. The proponent has leased a total of nine parcels of land from nine families for this particular project because it was not possible to get the required size of land from one individual in this area.

This ESIA study report is prepared pursuant to Section 58 of the Environmental Management and Coordination Act Cap 387 of the Laws of Kenya. Under the Second Schedule of the Act, Mining and other related activities including harvesting of aggregate, sand, gravel, soil and clay and exploration for the production of petroleum and minerals in any form are listed as high-risk projects which should undergo ESIA process. The study report will therefore provide a baseline of the environmental and social conditions of the proposed project area to enable future monitoring of the environmental performance of the proposed project.

The proposed project entails the establishment of a rock-quarry, Crusher for crushing the boulders into aggregates of different sizes, Concrete Batching Plant, Asphalt Mixing Plant, stock pile area and other support facilities. These facilities that are proposed by the proponent are meant to aid the dualling of Sagana-Marua (A2) road project. The project road for which the proposed project is being set up to facilitate its construction forms an integral section of the main road from port of Mombasa to Addis Ababa in Ethiopia via Nairobi, Isiolo and Moyale. In recent years the international route from Mombasa to Addis Ababa, has taken on a new potential importance. Following the Ethiopia /Eritrea war of 1999/2000 and the resulting loss of use by Ethiopia of the Eritrean ports after Eritrea's independence, all imports by sea to Ethiopia used the Port of Djibouti. But the Djibouti port has natural restrictions to its expansion and an alternative port has become increasingly desirable to Ethiopia.

The site that has been selected for the proposed project has agreements of nine families and with their support along with the support of neighbours, investigations over the modest time frame, were undertaken to prove the quarry source would meet qualities based around standard specifications for sealing chips for road surfacing, base course material for road foundation works, fines for asphalt manufacture and all in mix for concrete manufacture.

The leased parcels of land are ***L.R. NOS. KIINE/GACHARO/959, KIINE/KIBINGOTI/NGUGUINE/870, KIINE/KIBINGOTI/NGUGUINE 869, KIINE/KIBINGOTI/NGUGUINE/1538, KIINE/KIBINGOTI/NGUGUINE/1647, KIINE/KIBINGOTI/NGUGUINE/4187, KIINE/KIBINGOTI/NGUGUINE4188 KIINE/KIBINGOTI/NGUGUINE/1441, KIINE/KIBINGOTI/NGUGUINE 3306, KIINE/KIBINGOTI/NGUGUINE AND KIINE/GACHARO/960.*** *(Copies of the lease agreements are annexed)*

The methods adopted for preparing the ESIA study report were guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. Site visits were undertaken in November 2020 for purposes of area reconnaissance, assessing the baseline and environmental risks associated with the proposed project as well as the applicable environmental safeguards and standards. An Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. A second site visit was conducted on 24th and 25th February 2021 for public participation with the PAPS. As per this Schedule the issues considered by the experts included; ecological and socio-economic issues, landscape changes, land use character and water. Data collection methods included literature review of relevant documents, observations during site visits and photography. The stakeholder engagement meetings were held but in compliance with the Ministry of Health (MOH) guidelines on prevention of the spread of Covid -19. *(Minutes of stakeholder engagement meeting are annexed)*

The policies of relevance to the proposed project and the environmental policies in place for ensuring clean and health environment for all were reviewed. The primary objective of the environmental policies is to ensure that economic development is sustainable and does not destroy the natural resources on which it depends. Kenya has environmental legislations which seek to make developments sustainable; The Environmental Management and Co-ordination Act of 1999 revised 2015.

The proposed project is considered important and beneficial to the economic growth of Kenya and is coherent with the Kenya's Vision 2030. This ESIA proposes a comprehensive environmental management and a monitoring plan for the entire project cycle to address negative environmental impacts and improve the environmental performance of the project.

Potential Positive impacts of the proposed project facility

The proposed project will have positive impacts to the society and the general environment. Some of the benefits include the following: -

1. It will optimize use of the land; hence increasing its utility.
2. Increase economic investment hence increases in wealth which will translate in Government revenue increase.
3. The proponent will be able to effectively carryout the road construction works.
4. The project will also provide employment during both construction and operation phases both to the local populations and non-locals
5. It will create a market for goods and services, especially construction inputs which include cement, sand, steel and construction machinery.
6. Many secondary businesses are also likely to spring up during the operation phase especially those providing foods and beverages to the workers.

Potential negative environmental impacts

Anticipated Impacts

The anticipated impacts during the project`s entire cycle namely, construction, operation and decommissioning phase include;

- Change in land use
- Land degradation and contamination;
- Noise pollution and vibrations
- Air pollution
- Impact of electric blasting
- Contamination of water resources;
- Solid and liquid waste generation;
- Dust nuisance;
- Vegetation loss;
- Increase in vehicular traffic in the area
- Increased demand for water and electricity supply to the area;
- Occupational health and safety risks

Proposed mitigation measures for the likely impacts

Expected negative impacts	**Recommended mitigation measures**
Change in land use	• Apply for and obtain a change of user from the County Government of Kirinyaga and Ministry of Lands
Solid waste generation	• Ensure solid generated at the site are regularly disposed of appropriately at authorized dumping areas. Use of integrated solid waste management of options i.e. source reduction, recycling, composting and re-use, combustion and sanitary land filling • Carry out environmental awareness training to construction workers and plant employees during operation • A private company to be contracted to collect and dispose solid waste on regular basis
Release of sewage to the environment	• Effluent disposal to be done by use of conservancy tanks. • Apply for the license from NEMA for effluent disposal • Conduct regular inspection for the system to ensure it works effectively
High demand for water and effluent generation	• Obtain a permit to drill and abstract water from WRA • Sensitize the workforce on the need to conserve the available water resources • Procure and deliver to the site mobile toilets from a NEMA licensed waste contractor for use by the workers • Create water conservation awareness • Install a discharge meter at water outlets to determine and monitor total water usage • Promptly detect and repair of water pipes and tank leaks
Security	• Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the project site
Impact of electric blasting	• Inform the local community prior to blasting • All loading and firing shall be directed and supervised by competent person(s) • Employ qualified personnel to handle and store the explosives • Increase the number of delay detonators used in a round of blasting • Adhere to the provisions of the Explosives Act, 2012
High demand for electricity	• Switch off electrical appliances and lights when not in use • Install occupational sensing lights at various locations such as storage areas which are not in use all the time • Install energy saving fluorescent tubes

	• Monitor energy use during the operation of the project and set targets for efficient use • Sensitize workers to use energy efficiently
Air pollution	• Install appropriate and adequate dust screens around the project site • Ensure that the asphalt plant has anti-pollution equipment such as dust collector and bag house. • Regular maintenance of the asphalt duct line connecting the dryer and the dry dust collector. • Avoid excavation works in extremely dry weather • Regular sprinkling of water to be done on open surface and dusty grounds during dry season. • Comply with the Air Quality Regulations, 2014 • Ensure strict enforcement of on-site speed limit regulations and ensure driver observe them. • Procure, provide and enforce the use of dust masks to workers and visitors to the project site • Covering of all haulage vehicles carrying sand, aggregate and cement • Stockpiles of fine materials (e.g. sand and ballast) should be wetted or covered with tarpaulin during windy conditions. • The access roads and exposed ground must be wetted at a frequency that effectively keeps down the dust. • Workers in dusty areas on the site should be issued with dust masks during dry and windy conditions.
Noise and vibration disturbance	• Sensitize construction drivers to avoid running of vehicles engines or hooting. • Ensure the construction machinery are well kept in good condition • Sensitize construction drivers and machinery operators to switch off engines when not being used • Ensure all generators and heavy machines are insulated or placed in an enclosure to minimize ambient noise levels • Restrict noisy construction activities to normal working hours (8am -5pm). • Inform local residents beforehand, via notices and advisories, of pending noisy periods and solicit their tolerance well before the commencement works. • Workers operating equipment that generate high noise levels noise should be equipped with noise protection gear including ear muffs and plugs. Workers operating equipment generating noise levels greater than 80 dBA continuously for 8 hours or more should use ear protectors.

	• All construction equipment should be regularly inspected and serviced • Comply with the Noise and Excessive Vibration Pollution (Control) Regulations, 2009
Traffic control	• Issue notices/advisories of pending traffic inconveniences and solicit tolerance by local residents before the commencement of construction works. • Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the access road in the vicinity of the entrance to the site during the construction period. • Flagmen should be employed to control traffic and assist construction vehicles as they enter and exit the project site. • Maintain on site a record of incidents and accidents

CHAPTER ONE

1.0 Introduction

China Wu Yi Co Ltd has been awarded a contract by KENHA to carry to carry out construction works by dualling of Sagana-Marua (A2) Road project. To achieve this, the Company intends to establish an aggregate quarry, asphalt plant, concrete batching plant and a crusher on the nine parcels of land that have been leased from nine families.

Mining and other related activities including harvesting of aggregate, sand, gravel, soil and clay and exploration for the production of petroleum and minerals in any form are listed as high-risk projects under the Second Schedule (6i) of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya respectively. Pursuant to Section 58 of the Act, all high-risk projects listed under the Second Schedule should undergo an Environmental Impact Assessment (ESIA) process. Hence, the proponent contracted Ricla Environcare Consultancy which is a Firm of Experts licensed by NEMA to prepare an ESIA Study Report for the proposed project.

1.1 The objectives (purpose and need) of the project:

The overall objective of ESIA study report is to ensure that the environmental concerns are integrated in all development activities in order to contribute to sustainable development.

The objectives are;

- To identify the potential environmental impacts of the proposed quarry, crusher, batching plant and asphalt mixing plant.
- To assess the significance of these impacts.
- To assess the relative importance of the impacts of alternative plans, designs and sites.
- To propose the mitigation measures for the significant negative impacts of the project on the environment.
- To generate baseline data for monitoring and evaluation of how well the mitigation measures are being implemented during the project cycle
- To present information on the impacts alternatives to present results of the ESIA in such a way that they can guide informed decision-making.

The purpose of this project is to put up an aggregate quarry, asphalt plant, batching plant and a crusher to facilitate the dualling of Sagana-Marua (A2) road project.

1.2 Project alternatives

The alternatives to the project are different ways to achieve the same purpose and need that the proposed project will achieve.

1.2.1 Analysis of Project alternatives

The alternatives to the project are different ways to achieve the same purpose and need that the proposed project will achieve. ESIAs require looking into alternatives to the proposed project in order to make prudent decisions that will ensure sustainable development. The following alternatives were carefully considered.

1.2.2 Relocation alternative

The alternative in this case is to buy or lease land elsewhere in the neighbourhood and undertake a similar development. This alternative in the ends could be costly and inconveniencing to the proponent hence undesirable alternative to be undertaken. The proposed site is big enough in terms of land size which can accommodate the facilities that the proponent intends to put up and the site is easily accessible since it is approximately 1 KM off the Sagana-Marua road that the proponent will be undertaking its construction/improvement works.

1.2.3 The 'No project Alternative'

The No Project Alternative option in respect to the proposed project implies that the project achievements be reversed. Under the No Project Alternative, the proponent's proposal would not receive the necessary approval from NEMA. The construction of the proposed project will not take place and as such the **Sagana-Marua (A2) Road** will not be constructed/improved into a dual carriageway. In this scenario the people of Kirinyaga, Muranga and Nyeri where the proposed road passes through will continue to suffer with traffic jams hence delay to markets leading to loss of produce. The road which is a major transport corridor connecting Kenya and Ethiopia. The **No Project Option** is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- The government's infrastructure projects will not be implemented.
- No employment opportunities will be created for Kenyans who will work in the construction project.
- Increased urban/rural poverty and crime in Kenya.
- The government's vision 2030 will not be realized.

From the above analysis, it becomes apparent that the No Project alternative is not an alternative to the Proponent, Kenyans and the Government of Kenya.

1.2.4 The Proposed Development Alternative

Under the proposed development alternative, the developer of the proposed project will be issued with an ESIA License. In issuing the license, NEMA would approve the proponent's proposed quarry, concrete batching plant and asphalt mixing plant, provided all environmental measures are complied with during the construction period and operation phases. This

alternative consists of the applicant's final proposal with the inclusion of the NEMA regulations and procedures as stipulated in the environmental impacts to the maximum extent practicable. This was considered to be a viable option. This option was considered viable as opposed to the 'no project option' because:

- More jobs will be created in the construction industry;
- The purpose for which the project is being set up will help open up the rural areas making it easy to transport farm produce to the market and an improvement of A2 international road network that links Kenya to Ethiopia via Nanyuki, Isiolo and Moyale.
- It will result in further development and improvement of local infrastructure.

1.2.5 Analysis of alternative construction materials and technology

The proposed project will be constructed using concrete mortar for foundations of the concrete batching plant and Asphalt Mixing Plant that will be assembled on site. The setting up of the project will take into account public health, safety, security and environmental aesthetic requirements. Equipment that save energy and water will be given first priority without compromising on cost or availability factors. The concrete footings for the installation of the three main machines will be made using locally sourced stones, cement, sand (washed and clean), metal bars and fittings that meet the Kenya Bureau of Standards requirements. Heavy use of timber during construction is discouraged because of destruction of forests. The exotic species would be preferred to indigenous species in the construction where need will arise.

1.2.6 Wastewater Management Alternatives

Two most suitable technologies are discussed below:-

a) Alternative one: Connection sewer system

Connection to a main sewer line will solve the wastewater management issue at a very minimal cost and in an environmental efficient manner. This option is not available for the proposed site since there is no sewer line on site.

b) Alternative two: Use of septic tanks/conservancy tanks

This involves connecting of underground concrete-made tanks to store the sludge with soak pits. It is expensive to construct and regular empting in large discharge points like the residential project is also expensive and time consuming. However, in the absence of a sewer line, this remains the most appropriate option for the proponent. This option will be considered as the site is not served with a conventional sewer line.

a) Solid waste management alternatives

The proposed project will generate a lot of solid wastes. An integrated solid waste management system is recommendable. First, the proponent will give priority to Reduction at Source of the materials. This option will demand a

solid waste management awareness programme in the management and the residents. Secondly, Recycling, Reuse and compositing of the waste will be the second alternative in priority. This will call for a source separation programme to be put in place. The recyclables will be sold to waste buyers within the surrounding areas. The second priority in the hierarchy of options is combustion of the waste that is not recyclable in order to produce energy. For effective solid waste management, the Contractor will have to come up with a Waste Management Plan for the project.

1.2.7 Alternative Use of Proposed Project Site

Factors that make the proposed site suitable for the proposed project include:-

- Proximity to the road for which the project is being set up
- Availability of the required size of land for setting up such a facility
- Availability of the right quantities for rocks for aggregates

1.2.8 Technology Alternatives

The most challenging issues of construction work are control of dust and noise. The Proponent will undertake the construction by use of appropriate technology that will not result in dust and noise pollution to the neighbours

a. Preferred technology

Dust pollution is a major challenge in construction industry. There are ways in which dust can be arrested. The available technologies of controlling dust pollution in construction industry include use of dust screens. The effectiveness of the screens depends on their size. Very fine screens are more effective than less fine ones. Further the effectiveness of the screens will depend on if the entire construction area is well covered by the screens. Regular replacement of worn-out screens will add up to their effectiveness. Wet crushing technology will also help reduce dust during the crushing process. Sprinkling water with the use of water bourses along the access roads will also help by suppressing dust.

Construction work utilizes heavy machinery. Some of these machines can be a potential source of noise pollution. The contractor must ensure that he utilizes available noise reduction technology to reduce possible noise pollution. This can be achieved by utilizing noise reduction devices. This technology involves fitting silencers where applicable in machines that produce much noise. Silencers are very effective way of reducing noise pollution.

b. Other alternatives

Other available technologies of controlling dust at a construction site include: -

- Regular sprinkling water,
- Wet crushing

- Use of dust masks;

These technologies become more effective when used in combination with dust screens. The following recommendations are made:-

- Water to be sprinkled at least regularly as is reasonably practical on dusty ground to arrest dust during construction and operation phase;
- Disposable dust masks to be provided to employees especially those likely to be exposed to risk of dust;
- Employees to be sensitised on the importance of proper use of dust masks.

1.3 Project Description

This section highlights various aspects related to the proposed quarry, crusher, concrete batching plant and asphalt mixing plant.

1.3.1 Location

The project is located on nine parcels of land in Riamugaa village, Kibingoti sub-location, Kiini location, Kirinyaga County. The Global Positioning System (GPS) coordinates of the proposed site are Latitude -0.587866, 37.203170.

Plate1: Access road from the Sagana- Karatina highway

1.3.2 Components of the proposed project

Quarry and crusher

Three main processes will occur during mining i.e. blasting, loading and transportation of boulders to the crusher. Before blasting occurs, the quarrying site will be cleared of any vegetation. A vertical drill hole for loading explosives will then be made into the rock strata to determine the vertical extend of the ore's body. Both primary and secondary blasting will be undertaken for the purposes of breaking rock boulders into acceptable sizes for onward transportation to the crusher.

At the crusher, rocks will be passed through a system of conveyor belts and sieves where they will be broken into different categories of aggregate ranging from ½ to 10 inches as per the use required. The range between 4-10 inches is used for roads, railway lines and airport runways as base boulders.

Batching plant

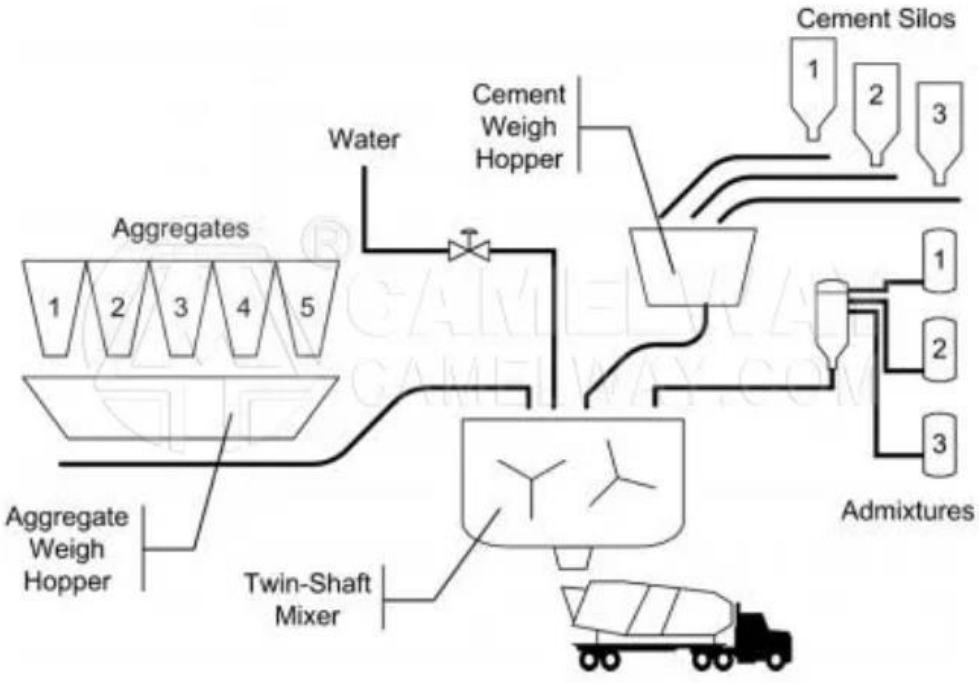

Figure 1: Typical component of a batching plant

Cement silos

- Domed roof with internal stiffeners to minimize water retention on roof Non slip chequer plate roof with surrounding handrails
- Water drain spouts that ensures that water does not run down side of silo
- Flat aeration base with large discharge pipe, maximizing flow
- Mild steel plate construction

- Angle leg construction with angle bracing and internal gusseting
- Channel ring reinforcement around base of silo
- Large diameter cement fill blow-in pipe
- Internal service pipe and access rungs
- Provision for dip stick, high level paddle probe and inspection hatch, and continuous level monitoring.

Cement air slides

Air slides ensure that the product is delivered quickly from silos to weigh hopper or direct into gob hopper. The air slides comprise of;

- Large 240 x 250 minimum aperture ensuring maximum flow
- Lightweight plate construction
- Internal baffle plates infinite adjustment to tweak the flow of delivery
- Multiple valves and air delivery hose for ample aeration to base
- Large discharge pipe
- Inspection hatches at both in-feed and out-feed ends enables ease of servicing or maintenance
- Bolt on polyester air mat
- Drip flange design minimizes water ingress into the air mat

Cement breather box

Reverse pulsating breather complete with control unit and solenoid valves. It will have the following features;

- Cylindrical pleated filter element
- Weather tight bolt on lid for ease of service
- Fully automated programmable self-cleaning sequence
- Controller with adjustable dwell times
- Solenoid control valves
- Ducting to ground

Cement weigh hopper

Cement weigh hoppers are extensively braced to offer maximum longevity and robust. Cement weigh hoppers features are;

- Mild steel plate construction
- Bolt on airside allowing for ease of replacement
- 55 degree minimum working angle
- Load cells with swivels and safety rod
- Vibrator mounts on 3 sides
- Inspection hatches
- Provisions for high level paddle probe and inspection hatch
- Breather filter unit

Ground bin

The ground bin will have the following features;

- 50 degree minimum working angles
- MS plate construction
- Multiple vibrator mounts
- Modular design for ease of replacement in the future
- Extensive external flat bar stiffening and ring channels/angles
- double gear gate

Surge bins feature

- 50 degree minimum working angles
- Heavy MS plate construction
- Multiple vibrator mounts
- Modular design for ease of replacement in the future
- Engineered support channel
- Load cells with swivels and safety rod or channel
- Extensive external flat bar stiffening and ring channels/angles

Gop hopper

Square aperture loading gob hopper with standard features;

- Bolt-on, modular steel wear liners
- Fully welded steel construction
- Integrated additive, water, and cement discharges
- Generous 700 x 700 discharge main aperture.

Pneumatic Piston Vibrator

Pneumatic vibrator compatible with universal vibrator mount; all units feature

- Face hardened impact piston
- Adjustable frequency and impact force
- Robust cast iron housing

Water management system

A large amount of water is used in concrete batching plants. Water is required to be added to dry concrete ingredients when supplied to an agitator and is also used to wash excess concrete from the inside and outside of the agitators used to transport batched concrete. A large amount of water is wasted and a large amount of fresh water is required regularly in existing concrete batching plants.

Water management system for concrete batching plant will include;

A plant operations area including one or more surfaces sloped so that surface water within the plant operations area runs to a single collection point.
A water catchment pit for collecting water at the single collection point; and water recycling apparatus for returning water held in the water catchment pit to the concrete batching plant for reuse.
The water catchment pit includes filtration apparatus for separating water held in the water catchment pit from particulate matter in that water.
The water management system further includes stirring apparatus for maintaining in suspension particulate matter in the water recovered by the water catchment pit prior to reuse in the concrete batching plant.

Asphalt Mixing Plant
Cold Aggregate Feeding System that will have;
Hoppers each equipped with belt conveyor controlled by frequency convertors. Bin-wall vibrators are mounted on the wall of sand hoppers to ensure the materials feeding. A screen fitted on the hopper to prevent oversize materials getting into the dryer drum. The feeder bin system is mounted with pulling switch for personnel safety.

Drying drum
Drying drum is one of the important components of an asphalt plant. It is equipped with a burner unit on one side of the rotating drum. The drum is inclined and allows the material to flow freely from one end to the other. The aggregates are transferred to the drying drum after they pass through a primary screening unit. Once inside the dryer, the high temperature inside the dryer will help to get rid of the moisture content in the aggregates.

Bucket elevator
As aggregates leave the drying drum they enter the bucket elevator. Bucket elevator is a long and covered structure going up to the top of the tower unit. On top of the tower unit there is vibrating screen. The bucket elevator has many buckets that are attached to a chain. This elevator unit will transfer the heated aggregates to the top of tower unit and help them enter the top of the vibrating screen unit.

Hot Aggregates Screening
On top of the tower unit there is a vibrating screen unit. This screening unit is multi layered and fully covered unit. Screens of different sizes are laid out in succession one below the other. As the aggregates fall on top of the first layer of the screen they will be treated to a vibrating effect. This vibrating effect will help the material to pass from one screen to the other. As they pass from one screen to the other the oversize material will be removed as they will not be able to pass through the top most screen.

Hot bins:

After the screening is over all the materials will be separated and stored in different compartments. These compartments are called hot bins. They store the aggregates and help in weighing the same before the aggregates are discharged into the mixing unit.

Mixing unit

Mixing unit receives aggregates from the weigh hoppers transferred from the hot bins. It also receives bitumen from the weigh hopper transferred from the bitumen tanks. Filler is also discharged from the filler weigh hopper before discharging the same into the mixing unit. Mixing unit will mix all the contents thoroughly for a fixed time before discharging the contents into the truck. Mixers are jacketed so that contents inside stay hot.

Bitumen storage and transfer tanks

Bitumen tanks act as storage point for bitumen used in the asphalt plant. Bitumen tanks are direct heating or indirect heating type. Direct heating type bitumen tanks will come with a burner fitted for heating of bitumen. The burner flame is led into a tube which will transfer the heat inside the tube for melting bitumen.

Dust collection system

Bag filter and pre separator are two important units for trapping harmful gases and dust particles. Pre separator will trap all the heavy dust. Bag filters with a number of bags close to each other in a closed chamber. As the gas sucked from the drying drum is made to pass through the bags they will be trapped. This action of the bag filters will help clean most of the pollutants and give out smoke with less pollution.

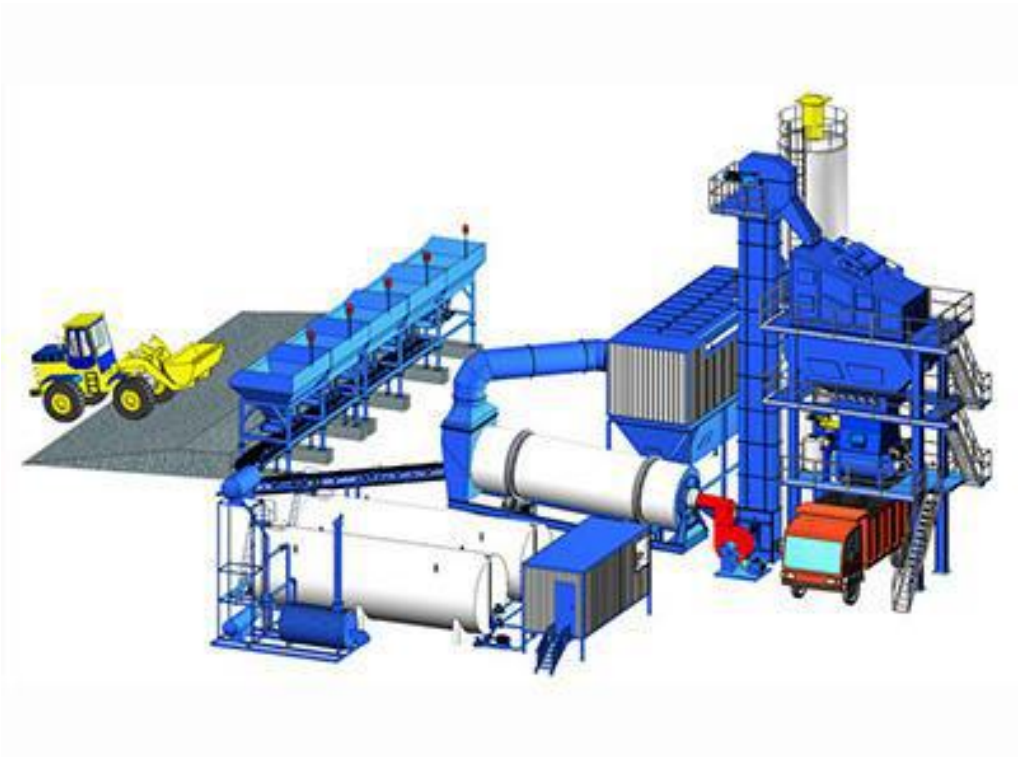

Figure 2: Typical component of an asphalt plant

1.4 Construction Equipment, Materials, Utilities and Waste

1.4. 1 Equipment

Equipment, machinery, materials and utilities that will be required for construction will be assembled at site. Equipment and machinery to be used will include excavators, rollers, dumper trucks, and cement mixers. A specific location within the site will be identified for these equipment.

1.4. 2 Materials

Materials to be used will include gravel, ballast, sand, cement, steel bars of various types and sizes. All of these materials and others that may be needed will be sourced locally.

1.4. 3 Utilities

Utilities that will be required for the project include water, diesel, electrical energy and labour. Water will be sourced from a borehole that will be drilled on site.

There are three possible sources of electricity that the project proponent may wish to exploit. These are:

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

Electricity from the national grid will be the most viable option.

1.4.4.4 Waste

Three main sources of waste are expected. These are: -

- Stockpile;
- Sanitary facilities;
- Wastewater as discussed in **1.2.6** above

Stockpile waste will include waste resulting from ground excavation and construction waste. Waste from sanitary facilities will be mainly wastewater and sewage which will be channeled into the septic tank as the place is not sewered.

1.4.4.5 Waste Management and Disposal

a) Waste from sanitary facilities

Wastewater and sewage from sanitary facilities will be channeled into the septic tank.

c) Technology to be used

During construction it is expected that dust disturbance will be of concern to neighbors. Noise disturbance is also likely to be of concern. The contractor will be required to use appropriate technology that will reduce possible dust and noise disturbances.

e) Dust Control Technology

Dust disturbance is a major challenge in construction industry. There are ways in which dust can be arrested. The available technologies of controlling dust pollution in construction industry include the use of dust screens. The effectiveness of the screens depends on their size. Very fine screens are more effective. Further the effectiveness of the screens will depend on how well the construction site is covered. Regular replacement of worn out dust screens will be essential in controlling dust pollution. Sprinkling water three times a day on dusty roads will also help reduce dust.

1.5 Design in response to the environment

a) Topography

The design of the site will be done with consideration of the existing topography of the place. Existing levels have been taken and implemented in the design to ensure that the existing landmass and strata is least disturbed during the development.

b) Water collection and storage

The design has taken into consideration the collection of water into water catchment pit for storage and reuse in concrete making process as well as sprinkling on the road to suppress dust.

b) Ventilation

The project facilities to serve as offices will be constructed in a manner that takes care of ventilation of the buildings.

c) Health, Safety and Environment

The provisions of firefighting equipment (extinguishers) have been carefully considered in the design and the escape door in case of fire outbreak. Environment Authority (NEMA) will be sought to ensure the development is responsive to all parameters.

N/B: Apart from the exaction works to lay concrete footings for the batching plant and Asphalt Mixing Plant, the other components comprise of steel parts will be assembled on site.

1.6 Estimate cost of the project

The estimated cost of setting up the site and the machinery to be installed will be approximately **Sixty Million Kenyan shillings (KSh. 60,000,000).**This is because most of the machines will be brought from previous projects that have been completed by the proponent.

CHAPTER TWO
2.0 METHODOLOGY

2.1 Screening

According to Environmental Management & Co-ordination Act 2015 (Second Schedule) and the Environmental (Impact Assessment & Audit) Regulations 2003 screening is an important tool in carrying out an ESIA. Screening was applied to determine whether an Environmental Impact Assessment was necessary and in determination of the level of assessment. The issues that were looked at included the nature of the expected impacts and the physical location.

2.2 Scoping

Scoping was employed to narrow down onto the most critical issues that will require assessment during this study. The environmental issues have been classified into physical, natural/ecological, and socio-economic and cultural aspects. Focus was drawn in the identification of the key environmental issues such as policy, technical, economic and social implications.

2.3 Desktop Study

This included the review of the documents related to the site of the proposed construction, project documents, designs, policy and legislative framework including the environmental setting of the area and discussion the Contractor's Engineers.

2.4 Site assessment

Site visits were done to not only physically inspect the site characteristics, but also to determine the anticipated impacts. It was during these visits that we randomly sampled a number of neighbours to fill in our questionnaires.

2.5 Reporting and documentation

The Environmental Impact Assessment Study Report from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared and submitted by the proponent for consideration and approval.

CHAPTER THREE:
3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 General Overview

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

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

According to Section 68 of the Environmental Management and Coordination Act (EMCA) 1999, The Authority shall be responsible for carrying out environmental audits on all activities that are likely to have a significant effect on the environment.
Environmental auditing (EA) is a tool for environmental conservation and has been identified as a key requirement for existing facilities to ensure sustainable operations with respect to environmental resources and socio-economic activities in the neighbourhood of the facilities.

The government has established regulations to facilitate the process on ESIAs and environmental audits. The regulations are contained in the Kenya Gazette Supplement No. 56, Legislative Supplement No. 31, and Legal Notice No. 101 of 13th June 2003. In the past, the government has established a number of National policies and legal statutes to enhance environmental conservation and sustainable development. ***The proponent will need to observe the provisions of the various statutes that are aimed at maintaining a clean, healthy and sustainable environment.***

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

3.2 Policies

3.2.1 National Environmental Action Plan (NEAP)

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

were introduced targeting the industrialists, business community and local authorities.

3.2.2 National Policy on Water Resources Management and Development

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

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

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

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

The key objectives of the Policy include: -

- To ensure that from the onset, all development policies, programmes and projects take environmental considerations into account,
- To ensure that an independent environmental impact assessment (ESIA) report is prepared for any industrial venture or other development before implementation,
- To come up with effluent treatment standards that will conform to acceptable health guidelines.

Under this paper, broad categories of development issues have been covered that require a "sustainable development" approach. These issues relate to waste management and human settlement. The policy recommends the need for enhanced re-use/recycling of residues including wastewater, use of low or non-waste technologies, increased public awareness and appreciation of a clean environment. It also encourages participation of stakeholders in the management of wastes within their localities. Regarding human settlement, the paper encourages better

planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others.

3.3 Legal Aspects

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

3.3.1 The Environment Management and Coordination Act, revised 2015

Part II of the Environment Management & Coordination Act, 2015 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment.

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

Part VII, Section 68 of the same Act requires operators of projects or undertakings to carry out environmental audits in order to determine level of conformance with statements made during the ESIA. The audit report should be submitted to NEMA. ***The project proponent will need to prepare and submit an environmental audit report in the first year of operation to confirm the efficacy and adequacy of the Environmental Management Plan.***

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

Section 87 sub-Section 1 states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while Section 88 provides for acquiring of a license for generation, transporting or operating waste disposal facility. According to Section 89, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste shall apply to the NEMA for a license. Sections 90 through 100 outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides.

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

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

To operationalize EMCA, several Regulations have been gazetted since its enactment in 1999 and its amendment in 2015. These relevant ones are;

1. **Environmental Management and Coordination (Impact Assessment and Audit) Regulations,2003**

These Regulations guide the preparation of EIAs including how experts should conduct the EIA process and guidelines and standards to be met by the reports. The Regulations were reviewed in 2016 to align them to the Kenya Constitution 2010. They were also recently amended (2019) to address challenges that have been reported since they were gazetted. This report complies with the provisions of these Regulations.

2. **Environmental Management and Coordination (Water Quality) Regulations, 2006**

These Regulations address the challenges of pollution of water resources and conservation.

It consists of VI parts and eleven schedules dealing with protection of sources of water for domestic use to miscellaneous provisions. For the proposed development, the proponent and contractor will implement measures to prevent water pollution from construction activities and effluent discharge at operational phase. Once the facility is operational, the proponent shall apply and obtain an Effluent Discharge License from NEMA.

3. **Environmental Management and Coordination (Waste Management) Regulations, 2006**

The Regulations focus on management of solid waste, industrial waste, hazardous waste, pesticides and toxic substances and radioactive substances. The regulations are aimed at addressing the impact of pollution from solid waste on the environment which become important sources of disease-causing pathogens. In compliance with these Regulations, the proponent will ensure proper waste disposal throughout the project cycle and procure the services of a NEMA licensed contractor for solid waste management.

4. Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

These Regulations were gazetted to manage noise levels to levels that do not cause a disturbance to the public. The operations at the site especially excavation and transportation by trucks are likely to generate noise above the acceptable limits. Appropriate PPE will be provided for employees engaged in activities that may produce noise above the acceptable limits within the facility (in excess of 60 dB (A).

5. Environmental Management and Coordination (Air Quality) Regulations, 2014

These regulations were aimed at controlling, preventing and abating air pollution to ensure clean and healthy ambient air. The proponent is obliged to address any source of air pollution from the operations of the poject.

3.3.2 The Water Act 2016

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

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

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

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

3.3.3 The Public Health Act (Cap. 242)

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

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

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

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

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

The proponent will be required to contract a licensed solid waste transporter to transport all solid waste from the site for dumping at approved sites. Sewage from the site will be discharged into the septic tank

3.3.4 The County Government Act (Cap. 265) Act, 2012

Section 160 helps county governments ensure effective utilization of the sewerage systems. It states in part that municipal authorities have powers to

establish and maintain sanitary services for the removal and destruction of, or otherwise deal with all kinds of refuse and effluent and where such service is established, compel its use by persons to whom the service is available.

Section 163 (e) gives powers to the county governments to prohibit businesses which by reason of smoke, fumes, chemicals, gases, dust, smell, noise, vibration or other cause, may be or become a source of danger, discomfort or annoyance to the neighbourhood, and to prescribe conditions subject to which such business shall be carried on.
The Proponent will mitigate against such impacts by ensuring strict adherence to the Environmental Management Plan provided in this study report throughout the project cycle.

Section 165 empowers the county governments to grant or to renew business licenses or to refuse the same.
Section 170, allows the right of access to private property at all times by county government officers for purposes of inspection, maintenance and alteration or repairs of sewers. To ensure sustainability in this regard, the local authority is empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and well-being of the inhabitants of its area as provided for under Section 201 of the Act.

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

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

3.3.5 The Physical and Land Use Planning Act, 2019
The Act provides for the planning, use, regulation and development of land and for connected purposes. It was enacted to ensure that every person engaged in physical and land use planning shall promote sustainable use of land and livable communities which integrates human needs in any locality. The Act allows the County Government to prepare a local physical and land use development plan in respect of a County, Sub-County, or unclassified urban area.
The proponent will be required to obtain pertinent approvals and requisite operational licenses from the County Government of Kirinyaga

3.3.6 Petroleum Act 2019

Section 5 states that the occupier of any premises in which petroleum is kept in contravention of any rules made under this Act shall be guilty of an offence.

Section 6 states that if any person to whom any license is granted under any rules made under this Act contravenes any of the conditions of license, he shall be guilty of an offence.

Petroleum rules, Part III Section 13(1) provides guidelines on storage of petroleum. According to the Section, no person shall store petroleum except in accordance with a license issued by the licensing Authority.

Petroleum rules, Part III Sections 19 and 29 provide guidelines on storage sheds and associated installations. According to Section 19(1), no person shall, in or near any storage shed or installation, do any act, which is likely to cause fire.

Petroleum rules, Part III Section 20 provides guidelines on precautions against fire. According to Section 20 (6), an efficient fire service shall be provided in every installation and the employees shall be instructed periodically in the use of various fire appliances.

Petroleum rules, Part III Section 22 specifies that the distances between tanks and between tanks and other buildings and between tanks and the boundaries of the installation shall, where the tanks are constructed below or partially below ground in accordance with the provisions of paragraphs (1) and (2) of rule 24 of the rules, be not less than three feet, and, in the case of tanks constructed above ground level the spacing shall be as specified in the schedule in Section 24 e.g. for tanks up to 12,000gallons capacity, minimum distance between tanks shall be 3 feet for both class "A" and class "B" petroleum whereas minimum distance between tanks and boundary of installation or buildings should be 10 feet.

The proponent will be required to provide appropriate firefighting equipment for dealing with potential fire outbreak and comply with the Energy Act 2019

3.3.7 The Building Code 2000

Section 194 requires that where a sewer exists, the occupants of the nearby premises shall apply to the water and sewerage company for a permit to connect to the sewer line and that all wastewater must be discharged into the sewers. The code also prohibits construction of structures or buildings on sewer lines. For this development septic tanks will be used for effluent disposal.

3.3.8 The Explosives Act, 2012

The Act regulates the purchase, assemblage, manufacture and use of explosive materials. Explosives are used routinely in many quarries for blasting and lessening of rocks. It also stipulates conditions for use, precautionary measures and storage requirements. The Act requires one to seek authority to acquire, transport and use blasting materials. It furthers makes it an offence liable for penalties to any person causing an explosion where life or property

is endangered. ***The proponent will be required to comply with the provisions of the Act.***

3.3.9 The Occupational Safety and Health Act, 2007

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

The key areas addressed by the Act include:

i) General duties including duties of occupiers, self-employed persons and employees
ii) Enforcement of the act including powers of an occupational safety and health officer
iii) Registration of workplaces
iv) Health General Provisions including cleanliness, ventilation, lighting and sanitary conveniences
v) Machinery safety including safe handling of transmission machinery, hand held and portable power tools, self-acting machines, hoists and lifts, chains, ropes & lifting tackle, cranes and other lifting machines, steam boilers, air receivers, refrigeration plants and compressed air receiver
vi) Safety General Provisions including safe storage of dangerous liquids, fire safety, evacuation procedures, precautions with respect to explosives or inflammable dust or gas
vii) Chemical safety including the use of material safety data sheets, control of air pollution, noise and vibration, the handling, transportation and disposal of chemicals and other hazardous substances materials
viii) Welfare general provisions including supply of drinking water, washing facilities, and first aid
ix) Offences, penalties and legal proceedings

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

officer of the respective area by an employer or self-employed person (section 21).

According to section 44, potential occupiers or users of any premises as work places are required to apply for registration to the Director for all premises intended for use as workplaces. Such places shall be maintained in a clean state during the operation phase (section 47).
To ensure machinery safety, every hoist or lift – section 63 and/or all chains, ropes and lifting tackles – section 64 (1d), shall be thoroughly examined at least once in every period of six months by a person approved by the Director of Occupational Health and Safety Services. Similarly, every steam boiler - section 67 (8) and/or steam receiver - section 68 (4) and all their fittings and/or attachments shall be thoroughly examined by an approved person at least once in every period of twelve months whereas every air receiver shall be thoroughly cleaned and examined at least once in every period of twenty four months or after any extensive repairs - section 69 (5). According to section 71 (3), every refrigeration plant capable of being entered by an employee also needs to be examined, tested and certified at least once in every period of twelve months by an approved person.

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

To promote health and safety of employees who are at risk of being exposed to chemical substances, section 84 (3) and 85 (4) requires every employer to maintain at the workplace material safety data sheets and chemical safety data sheets respectively for all chemicals and other hazardous substances in use and ensure that they are easily available to the employees.
The employers' positive contribution towards the welfare of the employees include provision and maintenance of adequate supply of wholesome drinking water - section 91 and a first aid box or cupboard of the prescribed standard – section 95 at suitable point (s) conveniently accessible to all employees.

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

The proponent will be required to ensure adequate measures to promote safety and health of workers during the construction and operation phases of the proposed project.

3.3.10 The Mining Act, (Cap 306).

Mining (safety) Regulations

Regulation 4 provides that**:**

(1) Where necessary for the prevention of danger to workmen or to other persons, the following shall be securely fenced or otherwise protected to the satisfaction of an inspector of mines—

*(a)*Temporarily disused excavations;

*(b)*The mouth of every shaft, winze or pit and the entrance to every underground working, whether above or below ground;

(c) Any places where mining operations have caused or are likely to cause subsidence's of the surface;

(d) Every elevated and exposed platform or gangway; and

(e) All exposed machinery which when in motion may be dangerous to persons.

Regulation 5 requires that:

i. No excavated material, tools, wood or loose articles of any kind shall be allowed to lie dangerously near the unprotected edge of any excavation.
ii. The ground or other material excavated from every trench shall be disposed so as to form ridges of approximately equal height at the sides and ends of the trench.

According to regulation 6 (1), disused excavations shall be filled or otherwise rendered safe to the satisfaction of the Commissioner.

Regulation 13 provides that in the opencast of alluvial or of soil, soft rock, gravel, clay, tailings, slimes, ashes, debris or other weak ground, no vertical face, unless securely timbered shall have a height of more than two and a half metres, but such unsupported open face shall be worked in terraces or at safe angle of slope.

Regulation 65 stipulates that a register or other sufficient record of all persons employed in or about the mine shall be kept to the satisfaction of an inspector of mines at the office of every mine.

CHAPTER FOUR
4.0 BASELINE INFORMATION

Introduction

The project is located on nine parcels of land in Riamugaa village, Kibingoti sub-location, Kiini location, Kirinyaga County. The Global Positioning System (GPS) coordinates of the proposed site are Latitude -0.587866, 37.203170.

Figure 3: The proposed site that comprises of nine parcels of land that have been leased by the proponent (source Google map accessed February 2021)

Baseline conditions of the proposed project site were assessed and documented for the purposes of determining the future impacts of the proposed project on the environment and livelihoods of the local community. This section details on the findings of the survey which will form a basis for impact monitoring plans and improvement of the environmental and social performance of the proposed project during implementation.

4.1 Site Status

The proponent had mobilized some equipment in redness for the works and some excavations had been done by the time the EIA team visited the site for the second time for the ESIA. The experts advised the proponent to hold on until the EISA license has been issued by the Authority.

Plate 2,3&4: Sections of the proposed site

4.2 Physiographic and Natural Conditions

4.2.1 Physical and Topographic Features

The county lies between 1,158 metres and 5,380 metres above sea level in the South and at the Peak of Mt. Kenya respectively. Mt. Kenya which lies on the northern side greatly influences the landscape of the county as well as other topographical features.

The mountain area is characterized by prominent features from the peak, hanging and V-shape valleys. The snow melting from the mountain forms the water tower for the rivers that drain in the county and other areas that lie south and west of the county. The Snow flows in natural streams that form a radial drainage system and drop to rivers with large water volumes downstream

4.2.2 Climatic conditions

The county has a tropical climate and an equatorial rainfall pattern. The climatic condition is influenced by the county position along the equator and its position on the windward side of Mt Kenya. The county has two rainy seasons, the long rains which average 2,146mm and occur between the months of March to May and the short rains which average 1,212 mm and occur between the months of October to November. The amount of rainfall declines from the high-altitude slopes of Mt. Kenya towards the Semi-arid zones in the eastern part of Mwea constituency. The temperature ranges from a mean of 8.1^{0}C in the upper zones to 30.3^{0}C in the lower zones during the hot season.

4.3. Administrative Units

The county is divided into five districts currently sub-counties namely; Kirinyaga East, Kirinyaga West, Mwea East, Mwea West and Kirinyaga Central. These districts are subdivided further into 12 divisions, 30 locations and 81 sub-locations.

4.4 Demographic characteristics

From the Kenya Population and Housing Census 2009 report, the population of the county stood at 528,054 persons with an annual growth rate of 1.5 percent. The population is projected to be 613,511 in 2019, 632,195 in 2021 and 651,449 in 2023.

4.5 Energy supply and use

Energy supplies include electricity, wood fuel, solar, wind and petroleum based fuels. Wood fuel is the most commonly used form of energy mainly in the rural households. Petroleum products are mainly used in the transport sector although products like kerosene are also consumed in great quantities by the households. These products are readily available in the markets. Energy sources like wind and solar are not fully utilized although there is a high potential mainly because of lack of appropriate technology especially in the rural interior.

4.6 Infrastructure

The county has an established road network with 7 major tarmac roads passing through it namely Makutano – Embu road, Kutus – Karatina road, Baricho road, Kiburu road, Kutus – Sagana road, Kutus – Kianyaga road and Kabare – Kimunye road. The gravel and earth surfaced roads in most areas

are however not motorable during the rainy season due to poor maintenance, poor drainage and unstable soils. There are 5 km of railway line and one railway station in the county located in Ndia Constituency but currently not in use. There is one airstrip located in Mwea constituency but is greatly underutilized.

4.7 Mineral resources

The mining activities carried out in the county are ballast mining which yields about 456,000 tonnes yearly and sand mining yielding about 294,000 tonnes annually. All mining activities are concentrated at Sagana area.

4.8 Water and sanitation

There are six main rivers in the county namely: Sagana, Nyamindi, Rupingazi, Thiba, Rwamuthambi and Ragati, which ultimately drain into the Tana River. These rivers are the principal source of water. Other resources are unprotected springs which are 29 in number, 12 water pans, 3 dams, and 208 shallow wells, boreholes & protected springs.

Water quality in the county is good in the upper parts where there are numerous springs, but in the lower parts of Mwea Constituency where tha main source are rivers, Thiba and Nyamindi, the water is contaminated due to use of fertilizers and pesticides in irrigation.

There is no sewerage system in the entire county and the households with flush system construct their own septic tanks. About 90 percent of the households use a pit latrine, while 6.2 percent use VIP latrines. The proportion with Flush toilets is 3.3 percent, Bucket 0.2 percent while 0.4 percent of the population has no form of sanitation.

4.9 Crop, Livestock

Agriculture is the most important activity in the county with 87 percent of the total population deriving their livelihood from the sector and accounting for 72 percent of household income.

CHAPTER FIVE

5.0 PREDICTION OF IMPACTS & PROPOSED MITIGATION

5.1 Introduction

The proposed project will have both socio-economic benefits and associated negative environmental and social impacts. The purpose of the ESIA process is therefore to systematically assess the value of the benefits against the environmental concerns and provide measures to avoid, prevent or reduce the magnitude of the impacts. The following section provides details on these impacts and proposed mitigation measures to address the identified negative environmental and social impacts. The mitigation measures are based on the underlying principle of ESIA that everyone is entitled to a clean and healthy environment and a duty to enhance and safeguard the environment.

5.2 Positive impacts of the proposed project

The following are the positive impacts of the proposed development.

5.2.1 Simulation of industrial development coherent with Kenya's Vision 2030

Mining ensures industrialization and development through the utilization of the country's mineral resources to catalyze diversified industrial development. This is in line with the Kenya Vision 2030 which aims at harnessing the mineral resources for industrial development and transforming Kenya into a newly industrializing middle income country.

5.2.2 Mitigating national and regional demand for aggregates

The establishment of the quarry will increase production of aggregate which will help mitigate the deficit in national and regional demand as well as provide adequate raw materials for construction of Sagana-Marua road.

5.2.3 Creation of employment opportunities

This proposed project will provide short term and long term employment opportunities for various experts and person(s) that will be hired during the planning and implementation activities. This will include both skilled and unskilled personnel especially from the local population. Hence, the experts and the local community members will derive income from the project for the three years period that the road project will be undertaken.

5.2.4 Source of revenue to the government

Both the County and National government will generate revenue in form of taxes generated during the acquisition of licenses and operations of the facility and also PAYE remitted from the employees' salaries.

5.2.5 Source of income to the landowners

The proposed facility through its operations will accrue income to landowners who have leased the land.

5.3 Negative environmental impacts

Alongside the project benefits, there are potential negative environmental impacts at the three phases of the project cycle. These are pre-establishment and establishment, operational and possible decommissioning phases. The proceeding sections discuss each of these phases' impacts on the environmental and the livelihoods of the local community.

5.3.1 Pre-establishment and establishment phase impacts

5.3.1.1 Occupational safety and health

The workforce and visitors to the site will be exposed to potential health and safety risks such as injuries that may result from accidental falls and the use of construction tools and equipment with a potential to cause injury, permanent disability or death. Further, workers may be exposed to high noise levels and dust which may cause health problems.

Mitigation measures

- Register the site as a work place with the Directorate of Occupational Safety and Health Services (DOSHS)
- Provide adequate and appropriate PPE and enforce their use
- Provide employees with correct tools and equipment for the jobs assigned and train on their use
- Obtain WIBA insurance cover for the workers at the site
- Provide first aid services and an emergency vehicle at the site
- Regulate the entry of visitors to the site by deploying adequate security measures
- Ensure moving parts of machines and sharp surfaces are securely protected with guards to avoid unnecessary contacts and injuries during construction phase
- Comply with the provisions of the Occupational Safety and Health Act 2007

5.3.1.2 Water demand and effluent generation

The construction activities will utilize substantial quantities of water for mixing and casting concrete, drinking and sanitation purposes which will lead to an increased demand for water. Water will be sourced from a borehole that will be drilled on site so as not to put stress on the community water supply.

Mitigation measure

- Procure and deliver to the site mobile toilets from a NEMA licensed waste contractor for use by the workers during the construction phase of the project cycle
- Comply with the Environmental Management and Coordination (Water Quality) Regulations, 2006

5.3.1.3 Solid waste generation

The workforce at the site and activities undertaken during site preparation and construction of auxiliary facilities are expected to generate significant quantities of solid waste such as cuttings, plastic materials and rejected materials among others. The proponent will therefore ensure proper management of solid waste to avoid potential risks associated with poor disposal.

Mitigation measures

- Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the construction site
- Create awareness on best waste management practices among the workers i.e. on the process of solid waste collection, segregation and proper disposal
- Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste
- Procure the services of a NEMA licensed waste handler to dispose the solid waste
- Comply with the Environmental Management and Coordination (Waste Management) Regulations, 2006

5.3.1.4 Air pollution

Sources of air pollution during the construction activities and installation of the crushing plant, concrete mixing plant and asphalt mixing plant will result mainly from excavation works, mixing of aggregates and from movement of vehicles carrying construction materials. If generated in large quantities, dust may present a respiratory hazard, cause eye irritation or visual intrusion. It will potentially affect the workers, visitors to the project site and the neighbors if it is in excess of 100 µg/m3.

Mitigation measures

- Restricting the speed of trucks and other vehicles accessing the project site to 20km/hr
- Sprinkling water on excavation areas and access roads

- Provision and enforcement of appropriate PPE to workers such as dust masks
- Develop and implement an air quality monitoring plan to ensure compliance with the limits set under Schedule 1 of the Environmental Management and Coordination (Air Quality) Regulations, 2014

5.3.1.5 Noise pollution

Noise and vibration emanating from vehicle accessing the site, excavation works and machinery operations may be a concern during operations at the site. Noise may lead to hearing impairments which will reduce the workmanship of the employees and also affect their finances due to treatment and medication. Construction sites such as the proposed quarry which are near residential areas can only emit noise levels of up to 60 dB(A) during the day and 35dB (A) during the night as per the Second Schedule of the Environmental Management and Coordination (Noise And Excessive Vibration Pollution) (Control) Regulations, 2009. Some of the project activities such as use of heavy machinery and equipment may produce noise levels which are above these limits and are a health hazard. While the noise at this stage is inevitable its impact can be mitigated in the following ways

Mitigation measures

- Provision and enforcement of appropriate PPE to workers such as ear muffs
- Truck drivers will be sensitized to avoid unnecessary hooting or running of vehicle engines
- Minimizing the frequency of transport of construction materials
- Compliance to the Environmental Management And Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009

5.3.2 Operational phase impacts

5.3.2.1 Land degradation

This mainly results from stripping of the topsoil and excavation to expose the rock strata. This will tamper with the soil structure exposing the site to possible landslides and soil erosion as well as interrupting the continuity of open space.

Mitigation measures

- Treat the quarry faces by initializing stabilization of the quarry pits walls through stepping of the faces to prevent erosion. This also reduces the risk of loose boulders falling from quarry faces during blasting
- Restore the affected areas through rehabilitation of decommissioned quarry pits and planting of indigenous plant species which create a stable final landform with acceptable post-mining land use capability

5.3.2.2 Removal and disposal of quarry overburden

Establishment of the quarry will result in generation of overburden comprised of top soils, vegetation and rock rumble. If inappropriately disposed, the overburden becomes an eyesore apart from harboring insects and disease causing vectors.

Mitigation measure

- Reusing overburden as backfilling material during site rehabilitation and restoration

5.3.2.3 Effects on landscape and visual intrusions

Stockpiles and quarry waste piling have a negative effect on the landscape by causing visual intrusion. Blasting activities usually destroy the original landscape of the affected area leaving behind huge depressions and a potential point of collecting water forming artificial ponds. These water pools have a potential to be hazardous and pose a threat to health. There is also a huge possibility that many of the surface features that were present before mining activities cannot be replaced after the process has ended.

Mitigation measures

- Take into consideration the existing landforms and vegetative cover in siting before drilling and excavation
- Locate stockpiles, overburden, quarry waste & haul routes away from sensitive landscape & visual receptors
- Backfill the quarry pits where applicable using the overburden generated during excavation

5.3.2.4 Impact on biodiversity

Sections of the proposed site will be cleared to pave way for excavation and other quarrying activities. Quarrying activities disrupts the macro habitat and the species they support. There are species that are resistant to such disturbances while others are adversely affected to the extent of completely disappearing from the mining zone. Endemic plant and animal species are most affected since they are very sensitive and they require specific environmental conditions, even the slightest disruption of their habitats can result in extinction or put them at high risk of being wiped out.

Dust produced will also have physical effects on the surrounding vegetation such as blocking and damaging internal structures hence impacting on their physiological activities. Vegetation provide habitat for organisms. They also protect ground surface from wind and water erosion and stabilizes other physical environmental attributes such as microclimate, water and soil moisture regimes which in turn influence organisms' abundance.

Mitigation measures

- Retain vegetation cover where possible within the site
- Rehabilitate the quarried areas and plant appropriate indigenous trees or approved exotic ones in collaboration with the Kenya Forest Service

5.3.2.5 Occupational health and safety

Quarrying and associated activities pose potential threats to the health and safety of workers on site. This may be in the form of dust from excavation works, fumes from machinery and vehicles accessing the site, accidents from machinery and equipment, injuries that may result from excavation activities and accidental falls. The quarry pits may also pose a threat to community health and safety as they may become important breeding grounds for disease causing pathogens especially during the rainy seasons, and accidental falls of both human and livestock in the water pools could lead to drowning.

Mitigation measures

- Register the site as a workplace with the Directorate of Occupational Health and Safety
- Provide adequate training to staff on health and safety
- Provide and enforce appropriate PPE among workers and visitors to the site
- Provide a fully equipped first aid box, first aid services and emergency vehicle at the site
- Provide the correct equipment to employees for the jobs assigned and trained on their use
- Designate a fire assembly point within the facility
- Set-up a fire safety plan for the facility
- Regulate access to the site by deploying adequate security measures and fencing where appropriate to protect workers, local community members and livestock from potential accidents
- Backfill the quarried areas to reduce the risk of becoming breeding ground for disease causing pathogens
- Ensure compliance with the provisions of the Occupational Safety and Health Act, 2007

5.3.2.6 Water demand and effluent generation

The proposed project will exert pressure on water for washing of vehicles and machinery, sanitation purposes, dust suppression and general housekeeping around the area during operations. 70% of the water use will be generated

as effluent while the rest will seep into the ground areas within the site. Effluent generated will need to be disposed of appropriately.

Mitigation measures

- Undertake quarterly analysis of the effluent water from the slurry water stabilization ponds
- Compliance with Environmental Management and Coordination (Water Quality) Regulations, 2006

5.3.2.7 Energy demand

The operations of the quarry, batching plant crusher and asphalt plant will increase the demand on energy for running the machinery and equipment and for lighting and powering of electrical appliances. Energy supply for development will be obtained from the national grid and supplemented by a standby generator.

Mitigation measure

- Maintenance of machinery and equipment in a serviceable and good working order to maximize their efficiency on fuel

5.3.2.8 Solid waste generation

The proposed facility will generate solid waste mostly in form of explosives packaging, oil and grease containers used for maintenance of machinery and overburden among others. These have a potential of pollution if not disposed of appropriately. The proponent will therefore ensure proper management of solid waste during the operation of the quarry through the following measures.

Mitigation measures

- Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the site
- Create awareness on best waste management practices among the workers i.e. on the process of solid waste collection, segregation and proper disposal
- Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste
- Procure the services of a NEMA licensed waste handler to dispose the solid waste
- Re-use quarry waste and soil materials piled at the site to refill (restore) the excavated areas that exist as a result of mining
- Complying with the Environmental Management and Coordination (Waste Management) Regulations, 2006

5.3.2.9 Air pollution

Dust from site operations/activities is a major source of air pollution. Mining requires soil to be removed which eventually causes the particles to become airborne through road traffic and wind erosion. The unrefined particles can be composed of toxic materials and ultimately affect the human health causing respiratory diseases. Blasting and crushing of the boulders will also produce lots of dust. In addition fumes and hydrocarbons produced by the heavy commercial vehicles and heavy machinery may lead to respiratory complications.

Mitigation measures

- Sprinkling water at the site to suppress dust, carrying out wet crushing
- Provision and enforcement of appropriate PPE to workers such as dust masks
- Retaining existing vegetation in areas which are not earmarked for quarrying or construction of the axillary facilities to act as dust screens and a buffer zone between the quarry area and the settlements
- Develop and implement an air quality monitoring plan to ensure compliance with the limits set under Schedule 1 of the Environmental Management and Coordination (Air Quality) Regulations, 2014

5.3.2.10 Noise pollution

The proposed project involves quarrying and crushing the stone boulders batching and asphalt mixing that generate significant amount of noise. These include blasting, use of powered machineries to transport the aggregates and processing plants that will crush and grade the materials. Excessive vibrations are mainly from drilling and crushing of the boulders is a nuisance and cause further disturbance to the environment.

Mitigation measures

- Use buffer zones by locating the quarry facility away from settlements
- Provide and enforce the use of earmuffs to all workers and visitors accessing noisy areas of the facility
- Increase the number of delay detonators used in a round of blasting so as to yield minimal ground vibrations and noise
- Conduct noise mapping to inform mitigation measures
- Comply with the Environmental Management And Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

5.3.2.11 Impacts of electric blasting

Blasting has both safety and health concerns during its deployment and eventual use of explosives. It exposes workers to airborne hazards from

naturally occurring gases, chemical vapors and principal hazard such as noise, segmental vibration and heat. Susceptible structures to ground vibrations cause disturbances to the occupants.

Mitigation measures

- All loading and firing shall be directed and supervised by competent person(s) thoroughly experienced in this field and accredited accordingly
- Employing qualified personnel to handle and store the explosives
- Providing and enforcing the use of earmuffs to all workers and visitors to the facility
- Increasing the number of delay detonators used in a round of blasting
- Adhere to the provisions of the Explosives Act, 2016

5.3.2.12 Ground and surface water pollution

Quarrying activities present potential ground and surface water pollution. The hydrogeology regime will be affected by the distinct aspects of surface mineral extraction and associated activities which will result in groundwater pollution. Removal of the rock strata can cause the floor to heave and allow for water seepage. Sometimes quarries are dug below the water table and hence toxic materials could seep into the ground water. The activities of the proposed quarry will have a potential to pollute the stream that runs along the boundary with the proposed site. Surface water pollution can be caused by acid mine drainage and loading of Sediment, debris and impurities from soil erosion or surface runoff.

Mitigation measures

- Ensure that blasting and drilling are not undertaken to the water table level
- In the event of flooding, water will be pumped out of the mines to avoid acid rock drainage and dissolution. In case of any contamination, pumped water will be treated to neutralize the contaminants
- Secure the site with an impermeable boundary wall to ensure that the mining tailings and overburden are contained within the site
- Maintain maximum existing vegetation coverage and plant more trees along the boundary wall to act as buffers

5.3.2.13 Impact of heavy trucks on roads

Once the quarry begins operations, there will be heavy commercial vehicles ferrying aggregates to different areas. Overloaded trucks may cause damage on the roads. To mitigate this impact the proponent and truck drivers will adhere to the axle load limits set by the Kenya Roads Board.

5.3.3 Decommissioning phase impacts

The lifespan of the quarry is dependent on the quantities of the rock deposit, technology used to mine and financial sustainability of the business. Other circumstances that may warrant decommissioning include withdrawal or expiry of licenses issued by government agencies, closure by government agencies, court orders and natural calamities. The proponent will prepare and submit a due diligence decommissioning audit report to NEMA for approval at least three (3) months in advance. The impact at this phase will include the following:

- Creation of an ecologically vulnerable land
- Economic decline
- Insecurity
- Safety and health risks

5.4 TYPICAL PROPOSED QUARRY REHABILITATION PLAN

5.4.1 Re-profiling

The objective of re-profiling is to reinstate soils to a more stable landform, which includes:

1. Re-establishing surface drainage lines
2. Reinstating the land surface that is visually consistent with surrounding land
3. Features re-profiling to original contours and established drainage lines
4. Minimizing the potential for subsidence/ erosion gullies to occur
5. Replacing top soil over subsoil

5.4.2 Contouring the site

Land form reinstatement involves surface contouring to create a stable land formation consistent with the surrounding land form. This ensures water flow over the surface is in cohesion with the surrounding landscape and minimizes the risk of potential erosion. It also ensures that the final landform is consistent with the surrounding land features. Surface contouring should be completed prior to re-spreading of topsoil.

5.4.3 Ripping and scarification

This will be undertaken along contours to assist with binding of the soil layers, increase retention time of water on the slope, aid water infiltration into the soil increasing the opportunity of seed germination success while reducing the volume and velocity of runoff generated from the slope. Ripping will be excluded from under the drip lines of retained vegetation to avoid impacts

on the root systems of adjacent vegetation. Scarification can be achieved by ploughing of the sub-surface material prior to topsoil reinstatement

5.4.4 Top soil re-spreading

This involves the reapplication of topsoil accumulated from the original clearing. Top soil will be re-spread to the following specifications:

1. Re-spread over watered and scarified or ripped subsoil's in even layers at a thickness appropriate for the intended land use of the area to be rehabilitated
2. Spread back over in an even layer and left "rough" (rather than smooth and compacted) to minimize potential erosion, increase water infiltration and to trap seed.
3. Topsoil will cover the entire width of the disturbed area so that there is no exposed sub-surface material. This ensures seeding and germination has the best opportunity to take, enabling establishment of groundcover
4. Topsoil application will only take place following initial reinstatement of the subsoil, construction of contour banks on steep slopes and compaction of subsoil's to account for subsidence
5. Topsoil stockpiled for extended periods will be turned over and mixed prior to replacement.
6. Vehicle movement will be restricted following topsoil re-spreading

5.4.5 Re-vegetation

The re-vegetation of the site will involve direct seeding of native species. This species selection is guided by soil conditions, micro-climate and aspect of the new land form. The ground cover will consist of native grasses or sterile exotic grasses to ensure exotic grasses do not become established.

Initial re-vegetation with suitable sediment binding ground cover is essential to provide soil stability. Final slopes and surface contours will approximate native gradients and will blend with adjacent topography. Consequently, subsidence and erosion from areas re-profiled and rehabilitated will be monitored.

6.0 CONSULTATIVE PUBLIC PARTICIPATION

6.1 The need for public consultation

ESIA process is largely determined by effective consultation and public participation (CPP) which basically provides a cornerstone for project planning and successful implementation. Consultation and Public participation helps to:

i. Facilitate involvement and participation of affected persons throughout the project cycle.
ii. Ensures a sense of responsibility and commitment towards implementing the proposed EMP.

CPP should be undertaken mainly during project planning, in implementation and decommissioning phases. It should involve the affected persons, lead agencies, private sector, among others. The methodology for CPP may include: meetings and technical workshops with affected communities; interpersonal contacts; Dialogue with user groups and local leaders; Questionnaire/survey/interview; and participatory rural appraisal or rapid rural appraisal (PRA/RRA) techniques.

It is the responsibility of the project proponent to adequately ensure effective distribution of the information to the affected persons to mitigate against unnecessary delays in decision making and project implementation.

6.2 Objectives of public participation

Public participation is essential for good governance and may empower local communities. Impact assessment is multi-purposive, aiming specifically to:

- Invite the affected and interested public into the decision-making process to foster justice, equity and collaboration;
- Inform and educate the stakeholders (who include the proponent, public, decision-maker(s) and the regulator) on the planned intervention and its consequences;
- Gather data and information from the public about their human (including cultural, socio-economic and political dimensions) and biophysical environment, as well as about the relations (including those related to traditional and local knowledge) they have with their environment.
- Seek input from the public on the planned intervention, including its scale, timing and ways to reduce its negative impacts, to increase its positive outcomes or to compensate impacts, which may not be mitigated;
- Contribute to better analysis of proposals leading to more creative development, more sustainable interventions and consequently greater public acceptance and support than would otherwise be the case; and

- Contribute to the mutual learning of stakeholders and to improvement of the public participation and impact assessment practice for a proposal.

6.3 Public Consultation with respect to the proposed project

It should be noted that the stakeholder engagement process was at risk due to the prevailing global pandemic of COVID-19 where the Kenya Government has responded by banning public gatherings. Due to this scenario, a small public consultation meeting was held in compliance with the Ministry of Health (MOH) guidelines on prevention of the spread of the virus. During this process, the ESIA team gave a brief presentation on the proposed project including the potential impacts and mitigation measures. The affected people were then asked to present their comments.

6.4 Results of the public consultation process

The stakeholders who filled the questionnaires were not objected to the proposed project. However, they requested the proponent to minimize the effects of noise and dust from the proposed quarry and axillary activities. The filled questionnaires and minutes have annexed in the report.

Plate 5, 6&7: The ESIA team getting views of the PAPS during a Public Baraza held at the site, the photos have been taken from different angles

7.0 RESETTLEMENT AND COMPENSATION ISSUES

Land acquisition and property compensation will mainly occur in one parcel of land where the quarry will be located and one family with two graves will be voluntary relocated

A cultural amenity however that raised issues was on the graves as whenever these were affected, the PAPS did not wish to think twice about. Relocation of graves is an emotional issue that needs to be addressed as they cannot be valued; hence the proponent intends to compensate the owners with token when the court order for its exhumation is ready. In as far as emotional relocation of graves, there is need for an intensive social engineering prior to the project implementation.

8.0 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) for a development project gives a logical framework within which the identified negative environmental impacts can be mitigated. The EMP also assigns action responsibilities to various actors and a timeframe within which mitigation measures and monitoring can be done. It is an important output of an ESIA process because it gives a checklist for project monitoring and evaluation

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN DURING CONSTRUCTION PHASE

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
Occupational safety and health risks	-Register the site as a workplace with DOSHS -Obtain insurance cover for the workers at the site -Procure and provide adequate and appropriate PPE to workers and visitors to the site and enforce on their use -Provide the correct equipment to employees for the jobs assigned and trained on their use -Secure moving parts of machines and sharp surfaces with guards to avoid unnecessary contacts and injuries -Provide a fully equipped first aid box, first aid services and emergency vehicle at the site -Comply with the provisions of the Occupational Safety and Health Act, 2007	Proponent/contractor Throughout construction	Prior to commencement During construction	**TBD**

Air pollution	Install appropriate and adequate dust screens around the project site	Proponent/contractor	Throughout construction	500,000
	Sprinkle water on the construction site to suppress dust	Proponent/contractor	Daily	3,000
	Procure, provide and enforce the use of dust masks to workers and visitors to the project site	Proponent/contractor	Throughout construction	10,000
	Designate speed limits and sensitize the drivers to observe them	Proponent/contractor	During construction	Nil
	Comply with the Air Quality Regulations, 2014	Proponent/contractor	Throughout construction	Nil
Noise pollution	Procure and provide adequate PPE such as earplugs/muffs to workers and visitors to the site	Proponent/contractor	Throughout construction	30,000
	Service machinery and equipment regularly to ensure that they are in good condition	Proponent/contractor	Throughout construction	Internal costs
	Sensitize truck drivers to avoid unnecessary hooting or running of vehicle engines	Proponent/contractor	Throughout construction	Nil
	Comply with the Noise and Excessive Vibration Pollution (Control) Regulations, 2009	Proponent/contractor	Throughout construction	Nil
Solid waste generation	Reuse the generated overburden in backfilling Procure and provide adequate solid waste collection bins with a capacity for segregation	Proponent/contractor	Throughout construction	200,000

	Create awareness on best waste management practices Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste Comply with the Waste Management Regulations, 2006			
Cement/Concrete Batching	-Concrete batching plant shall be located more than 20 m from the nearest stream/river channel; -Topsoil shall be removed from the batching plant site and stockpiled; -Concrete shall not be mixed directly on the ground; -The concrete batching works shall be kept neat and clean at all times; -Contaminated storm water and wastewater runoff from the batching area and aggregate stockpiles shall not be permitted to enter streams but shall be led to a pit where the water can soak away; -Unused cement bags are to be stored so as not to be effected by rain or runoff events; -Used bags shall be stored and disposed of in a manner which prevents pollution of the surrounding environment (e.g. via wind-blown dust);	Supervising Engineer and the Contractor.	Construction	No additional cost

	-Cleaning of equipment and flushing of mixers shall not result in pollution of the surrounding environment; -Suitable screening and containment shall be in place to prevent windblown contamination associated with any bulk cement silos, loading and batching; -Waste concrete and cement sludge shall be scraped off the site of the batching plant and removed to an approved disposal site; -All visible remains of excess concrete shall be physically removed on completion and disposed at an approved disposal site. Washing the remains into the ground is not acceptable; -All excess aggregate and sand shall also be removed;			
Asphalt, Bitumen and Paving	-The plant should be situated on flat ground; -Topsoil shall be removed prior to site establishment and stockpiled for later rehabilitation of the site; -Bitumen drums / products shall be stored in an area approved by the RE. The area shall be covered to prevent rainwater from contacting the areas	Supervising Engineer and the Contractor.	Construction	No additional cost

	containing fuels, oils, bitumen etc and potentially generating contaminated runoff; -The plant shall be secured from trespassers and animals through the provision of fencing and a lockable gate to the satisfaction of the RE; -Well-trained staff shall be responsible for plant workings. -Within the bitumen plant site, areas shall be demarcated/marked for plant materials, wastewater and contaminated water; -An area should be clearly marked for vehicle access; -Drums/tanks shall be safely and securely stored; -Materials requiring disposal shall be disposed of by a licensed waste disposal agent			

ENVIRONMENTAL MANAGEMENT PLAN DURING THE OPERATION PHASE

Impacts expected	Recommended mitigation measures	Responsibility party	Cost	Time frame
Land degradation	-Treat the quarry faces by initializing stabilization of the quarry pits walls through stepping of the faces to prevent erosion -Restore the affected areas through rehabilitation of decommissioned quarry pits and planting of indigenous plant species	Proponent	Minimal	During operations Upon decommissioning of quarry pit
Blasting	-Inform the local community prior to blasting -All loading and firing shall be directed and supervised by competent person(s) -Provide and enforce the use of earmuffs to all workers and visitors to the facility -Increase the number of delay detonators used in a round of blasting -Adhere to the provisions of the Explosives Act, 2012	Proponent	Minimal	During operations
Air pollution	-Adopt the wet crushing technology to minimize amount of dust generated during crushing of boulders -Retain the existing vegetation in areas which are not earmarked for quarrying -Develop and implement an air quality monitoring plan Comply with the Air Quality Regulations, 2014	Proponent	400,000 annually	During operations

	-Comply with the provisions of the Occupational Safety and Health Act, 2007			
Noise pollution	-Ensure that the vibration levels do not exceed 0.5 centimeters per second beyond the facility boundary wall -Increase the number of delay detonators used in a round of blasting so as to yield minimal ground vibrations and noise -Provide and enforce the use of earmuffs to all workers and visitors accessing noisy areas of the facility -Comply with the Noise and Excessive Vibration Pollution Control) Regulations, 2009 -Comply with the provisions of the Occupational Safety and Health Act, 2007	Proponent	500,000 annually	During operations
Sanitation	The Contractor shall comply with laws and by-laws relating to public health and sanitation; -All temporary/ portable toilets or pit latrines shall be secured to the ground. -The type and exact location of the toilets/septic tanks shall be approved by the RE. -All toilets shall be maintained by the Contractor in a clean sanitary condition. -A wash basin with adequate clean water and soap shall be provided alongside each toilet.	Proponent	To be specified in construction contract	Construction

Ground and surface water pollution	-In the event of flooding, water should be pumped out of the mines to avoid acid rock drainage and dissolution -Maintain maximum existing vegetation coverage and plant more trees along the boundary to act as buffers -Secure the site with a chain link fence to ensure that the mining tailings and overburden are contained within the site	Proponent	5000per month	During operations
Security	-Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premise	Proponent	15,000per month	Continuous
Fire control	-Fire extinguisher to be placed at strategic positions -Escape routes to be provided -Servicing of fire extinguishers as is necessary. -Always inspect electricity connections	Proponent	100,000 annually	Continuous
High demand for electricity	-Switch off electrical lights when not in use -Install energy saving fluorescent tubes -Monitor energy use during the operation of the project and set targets for efficient use	Proponent	2000 per month	Continuous

DECOMMISSIONING STAGE			**Responsibility**	**Cost**	
Environmental issues	-Effect of the operations had on environment	Conduct an ESIA study and prepare detailed decommissioning plan	Proponent	Market value at that time	At the end of the project life
	-Implementation of work	Set up a team to foresee decommissioning work	Proponent	Market value at that time	

8.0 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusions

The analysis of the ESIA has evidenced that the construction and operation of the proposed project will have positive impacts to the people of Kirinyaga County and the country at large. The impacts will include employment creation for both skilled and unskilled labour. However, despite the outlined positive impacts, the proposed development will have some negative impacts such as increased pressure on existing infrastructure, pollution (to Air, Water, soil) mostly during construction phase, and increased waste (solid and liquid) generation among others.

The proposed project design has integrated mitigation measures with a view to ensuring compliance with all the applicable laws and procedures. The structures will be built to the required planning/architectural/structural standards of Kirinyaga county government and the Ministry of Public Works. During project implementation and occupation, *sustainable environmental management (SEM)* will be ensured; avoiding inadequate use of natural resources, conserving nature sensitively and guarantees a respectful and fair treatment of all people working on the project, general public at the vicinity of the project.

In relation to the proposed mitigation measures that will be incorporated during construction and operational/occupation phases; the development's input to the society; the project is considered beneficial and important. It is our considered opinion that the proposed development is a timely venture that will subscribe to the country is Vision 2030. It is thus our recommendation that the project be allowed to go ahead with the implementation provided the outlined mitigation measures are adhered to. Major concerns should nevertheless be focused towards minimizing the occurrence of impacts that would degrade the general environment. This will however be overcome through close adherence and implementation of the recommended Environmental Management and Monitoring Plans (EMPs).

Finally, the project proponent has promised to work closely with the Environmental Experts and relevant government bodies to enhance the facilitation of the issues of concern. This will ensure that environmental concerns are integrated into the project at every stage of the implementation phase and the co-existence of the proposed project with the environment during and after-occupation.

APPENDICES

Questionnaire forms

Public consultation minutes

Lease Agreements

EIA Team licenses