Environmental and Social Impact Assessment Study Report for the proposed aggregate quarry on Plot L.R. No. KJD/Loodariak/444, Kajiado County.

Proponent	Firm of Experts
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Version: Final Report
Date: September, 2020

CERTIFICATION

Certification by Lead Experts

We hereby certify that this Environmental and Social Impact Assessment (ESIA) Study Report has been done under our supervision and that the assessment criteria, methodology and content reporting conform to the requirements of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.

Signed: _____ _____

Names: **Mr. Simon Nzuki** (1350) **Ms. Jane Gitau** (2015)

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Certification by Proponent

We, **Emet Limited,** confirm that this Environmental and Social Impact Assessment (ESIA) Study Report has been submitted to NEMA with our authority as the project proponent.

Signed for and on behalf of **Emet Limited**

Name: _____ Signature: _____

Date: _____

Proponent Contact Details

Emet Limited,
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Nairobi.

Official Rubberstamp or Seal

ACKNOWLEDGEMENTS

The preparation of this ESIA study report was made possible by a collaborative effort involving the proponent, the consultants and project stakeholders. We acknowledge the proponent who provided project documentation, coordinated site visits and provided the financial resources required by the consultants to undertake the ESIA process. To this end we acknowledge the assistance accorded to the EIA team by Mr. John Longisa.

Sampling and analysis of environmental media which included soil, noise and air was undertaken by Polucon Services (K) Limited. Biodiversity survey was undertaken by Mr. Sunday Abuja. The consultants are grateful for their invaluable input in the preparation of the ESIA study report.

We are indebted to the neighbors for accepting to participate in the public consultations and providing their views, comments and concerns in respect to the proposed project.

The staff of Envasses Environmental Consultants assisted the consultants in data and information collection, interpretation and analysis, preparing the proceedings of the consultative meeting and the printing of the final report. In this regard, we acknowledge the input of Ms. Gladys Kasichana and Ms. Hellen Maingi.

EXECUTIVE SUMMARY

In July 2020, Emet Limited contracted Envasses Environmental Consultants Limited to prepare an Environmental and Social Impact Assessment (ESIA) Study Report for the proposed aggregate quarry. The ESIA 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 study process. The study report will 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 will feature an open cast mine and auxiliary facilities such as access roads, power, water, site offices, sanitary facilities, generator room and explosive stores among others. Three main process will occur during mining; blasting, loading and transportation of boulders to the crushers which will break them into different categories of aggregate. The average production per day is estimated at 700 tonnes.

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 July 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. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. 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 as required were deterred by the ongoing COVID-19 pandemic that has resulted in a ban of all public gatherings by the Government of Kenya. However, public consultations were undertaken through structured questionnaires in compliance with the NEMA guidelines. Baseline Environmental media quality was measured through analysis of soil, air and noise in collaboration with a National Environment Management Authority (NEMA) designated laboratory, Polucon Services (K) Limited.

The proposed project will have both positive and negative impacts. The positive impacts will include stimulation of industrial development coherent with Kenya's Vision 2030, mitigation of national and regional demand for aggregates, source of revenue to both the County and National Governments, income generation to the proponent and creation of employment opportunities. However, negative impacts on the environment will also manifest during the pre-establishment and establishment, operational and possible decommissioning phases of the aggregate quarry.

At the pre-establishment and establishment phase, the potential negative impacts will include change in land use, environmental risks of obtaining raw materials for construction works, occupational safety and health, water demand and effluent generation, solid waste generation, air and noise pollution.

At the pre-establishment phase, the proponent will obtain a change of user from the County Government of Kajiado before commencement of work. To mitigate the impacts of the environmental risks associated with soucing of raw materials for construction of the auxiliary facilities, the contractor will ensure sufficient quantities of materials are procured for the intended works and they are sourced from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 Laws of Kenya.

The workforce and visitors to the site will be exposed to potential health and safety risks such as injuries and potential accidental falls. To mitigate these impacts, the proponent will register the site as a workplace with the Directorate of Occupational Safety and Health Services (DOSHS), provide and enforce the use of Personal Protective Equipment (PPE), provide the correct equipment for the jobs assigned and train the employees on their use, obtain insurance cover for the employees and comply with the provisions of the Occupational Safety and Health Act, 2007. The proponent will also procure and deliver to the site mobile toilets from a NEMA licensed solid waste contractor for use by the workers during the construction phase of the project cycle and ensure compliance with the Environmental Management and Coordination (Water Quality) Regulations, 2006.

Construction activities and workers are expected to generate solid waste. These will be disposed off by contracting the services of a NEMA licensed waste handler in compliance with the Environmental Management and Coordination (Waste Management) Regulations, 2006. Air and noise pollution from construction activities and establishment of the quarry is inevitable. The report recommends sprinkling of water on excavation areas, provision and enforcement of the use of PPE and ensuring compliance with the Environmental Management and Coordination (Air Quality Regulations), 2014 and Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

Quarrying operations have the potential to cause adverse effects on the environment including land degradation, impacts of quarry overburden, occupational health and safety, increased water demand and wastewater generation, increased energy demand, solid waste generation, air and noise pollution, ground and surface water pollution, impacts of electric blasting, impact on biodiversity and road damage.

The proposed project site is located approximately 7.5 km from the main road. The road leading to the site is narrow and almost impassable. Some sections of the road are dilapidated while others are overgrown with thorny bushes. The proponent will widen the access road to the project site to improve accessibility, grade the dilapidated sections of the access road and erect traffic warning signages and observe speed limits of 20km/hr.

Land degradation will result from stripping of the topsoil and excavation to expose the rock strata. The proponent and contractor will treat the quarry faces by initializing stabilization of the quarry pits walls and restoring the affected areas through rehabilitation of decommissioned quarry pits. Quarry overburden if inappropriately disposed becomes an eyesore and can be a potential breeding ground for insects and disease-causing vectors. The proponent will use the overburden during quarry rehabilitation for backfilling.

Sections of the proposed site that will be cleared to pave way for excavation and other quarrying activities will disrupt the macro habitat and the species they support. Dust produced from quarrying activities also have physical effects on the surrounding vegetation such as blocking and damaging internal structures hence impacting on their physiological activities. To reduce the impacts of quarrying to the ecosystem, the proponent will retain vegetation cover where possible and rehabilitate the quarried areas by planting appropriate indigenous trees or approved exotic ones in collaboration with the Kenya Forest Service.

Quarrying activities continue to hit the headlines regarding work-based accidents the most recent being fatalities in Kieni area of Nyeri County after quarry walls collapsed burying two alive. Vibrations and tremors from blasting activities can cause cracks on land and adjacent developments thus weakening them. These cracks can eventually widen causing collapse of buildings and landslides. Similarly, inhalation of airborne pollutants such as dust or exhaust fumes, high noise and

vibration levels, injuries from use of equipment, falls and trips, as well as injuries from flying rocks from blasting activities all pose potential threats to the health and safety of workers on site and neighbours to the site. Abandoned and unrehabilitated quarry pits may also pose a threat to community health and safety as well as livestock as they may become breeding grounds for disease causing vectors especially during the rainy seasons. To mitigate this impact, the proponent will provide adequate training to staff on health and safety and ensure use of correct machinery for each assignment given, provide and enforce the use of PPE, 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, rehabilitate quarried areas and comply with the provisions of the Occupational Safety and Health Act, 2007. The proponent should also undertake a comprehensive geological survey to determine stability of the area and slopes.

Water use at the facility will be mainly for dust suppression, cooling machines, cleaning and for sanitation purposes. Water used for dust suppression will seep into the ground thus effluent generated will be domestic in nature. This will be managed through a bio-digester and the proponent will apply and obtain an Effluent Discharge License from NEMA. Solid waste generated will be managed by a NEMA licensed solid waste contractor. The proponent will also ensure compliance with the Environmental Management and Coordination (Waste Management) Regulations, 2006.

The quarry will exert pressure on energy for running the machinery and equipment and for lighting and powering of electrical appliances. The study recommends maintenance of machines and equipment to maximize their efficiency on fuel and undertaking energy audits every 3 years and implementing the recommendations given.

Dust from quarrying activities i.e. from blasting, crushing and transportation of aggregates will be mitigated by sprinkling water at the quarry site, enforcing the use of PPE to all employees and visitors while at the facility, retaining existing vegetation in areas which are not earmarked for quarrying to act as dust screens and a buffer zone between the quarry area and the settlements and complying with the provisions of the Air Quality Regulations, 2014.

Quarrying involves several activities that generate significant amount of noise and vibrations which are a health hazard if above the stipulated World Health Organization (WHO) and Occupational Safety and Health (OSH) limits. To mitigate the impact of noise, the proponent will use buffer zones by locating the quarry facility away from settlements, enforce the use of earmuffs, increase the number of delay detonators used in a round of blasting, conduct noise mapping to inform mitigation measures, comply with Noise and Excessive Vibration Pollution (Control) Regulations, 2009 and adhere to the provisions of the Explosives Act, 2012. Blasting also poses safety and health concerns during its deployment and eventual use of explosives. This impact will be mitigated through ensuring a competent and accredited person(s) supervises all loading and firing, enforcing the use of earmuffs to all workers and visitors to the facility, increasing the number of delay detonators used in blasting, employing qualified personnel to handle and store the explosives and adhering to the provisions of the Explosives Act, 2012.

There is a potential for ground and surface water pollution during operations. Removal of the rock strata can cause the floor to heave and allow for water seepage and hence toxic materials from the quarry could seep into the ground water. The proponent will ensure that blasting and drilling are not undertaken to the water table level and in the event of flooding, water will be pumped out of the mines. The proposed site will be secured with an impermeable boundary wall to ensure that the mining tailings and overburden are contained within the site. The study also recommends

maintaining maximum existing vegetation coverage and planting of more trees along the boundary wall to act as buffers.

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

A decommissioning phase is possible in the event of closure by government agencies due to non-compliance with environmental and health regulations, end of project life, an order by a court of law due to non-compliance with existing regulations and Change of user. Key environmental concerns at this phase will be loss of livelihoods for the employees and income to the proponent. The proponent will prepare and submit a due diligence decommissioning audit report to NEMA for approval at least 3 months in advance.

The proposed project is considered important and beneficial to the economy as it will contribute towards realization of the Kenya Big Four Agenda and will provide aggregates for the construction industry. Despite the environmental concerns expected to arise at all phases of the project cycle, the ESIA team has recommended mitigation measures, environmental management plans for all phases of the project cycle and monitoring plans that will address the potential environmental and social impacts.

It is on this basis that we recommend that the project be allowed to proceed alongside conditions which will ensure compliance with the provisions of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.

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ACRONYMNS

CO_2	Carbon Dioxide
CSR	Corporate Social Responsibility
DOSHS	Directorate of Occupational Safety and Health Services
EA	Environmental Audit
EDL	Effluent Discharge License
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
GoK	Government of Kenya
GPS	Global Positioning System
HCVs	Heavy Commercial Vehicles
MOH	Ministry of Health
N_2O_4	Nitrogen Tetroxide
NEMA	National Environment Management Authority
NO_2	Nitrogen Dioxide
OSH	Occupational Safety and Health
PAYE	Pay As You Earn
PPE	Personal Protective Equipment
TBD	To be Determined
TORs	Terms of References
VOC	Volatile Organic Compounds
WHO	World Health Organization
WRA	Water Resources Authority

1 PROJECT BACKGROUND INFORMATION

1.1 Introduction

In the recent past, there has been rapid population growth and an ever-increasing large number of projects requiring significant amounts of construction material such as aggregates. To satisfy the growing demands of the construction industry. the proponent, Emet Limited proposes to set up an aggregate quarry on Plot L.R. No. KJD/Loodariak/444 in Esonorua area of Kajiado County. Once the aggregate deposits are depleted, the quarry pits may be used as waste disposal sites during the quarry rehabilitation and restoration process.

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 and Social Impact Assessment (ESIA) Study process. Hence, the proponent contracted Envasses Environmental Consultants Limited which is a Firm of Experts Licensed by NEMA to prepare an ESIA Study Report for the proposal. In addition to compliance with the law, the purpose of scoping report and TORs is to define the geographical and technical scope to be covered by the ESIA Study.

1.2 Project location

The proposed project will be located in Esonorua area in Kajiado Sub County, Kajiado County at **Latitude 1°41'5"S and Longitude 36°20'0"E** (Figure 1) approximately 7.5 Km from the main road. The project site lies within the Esonorua plains and borders an escarpment.

The people of the area mainly practice nomadic pastoralism but there are subsistence farms cropping up within the neighbourhood. No residential settlements are found within proximity of the proposed project site.

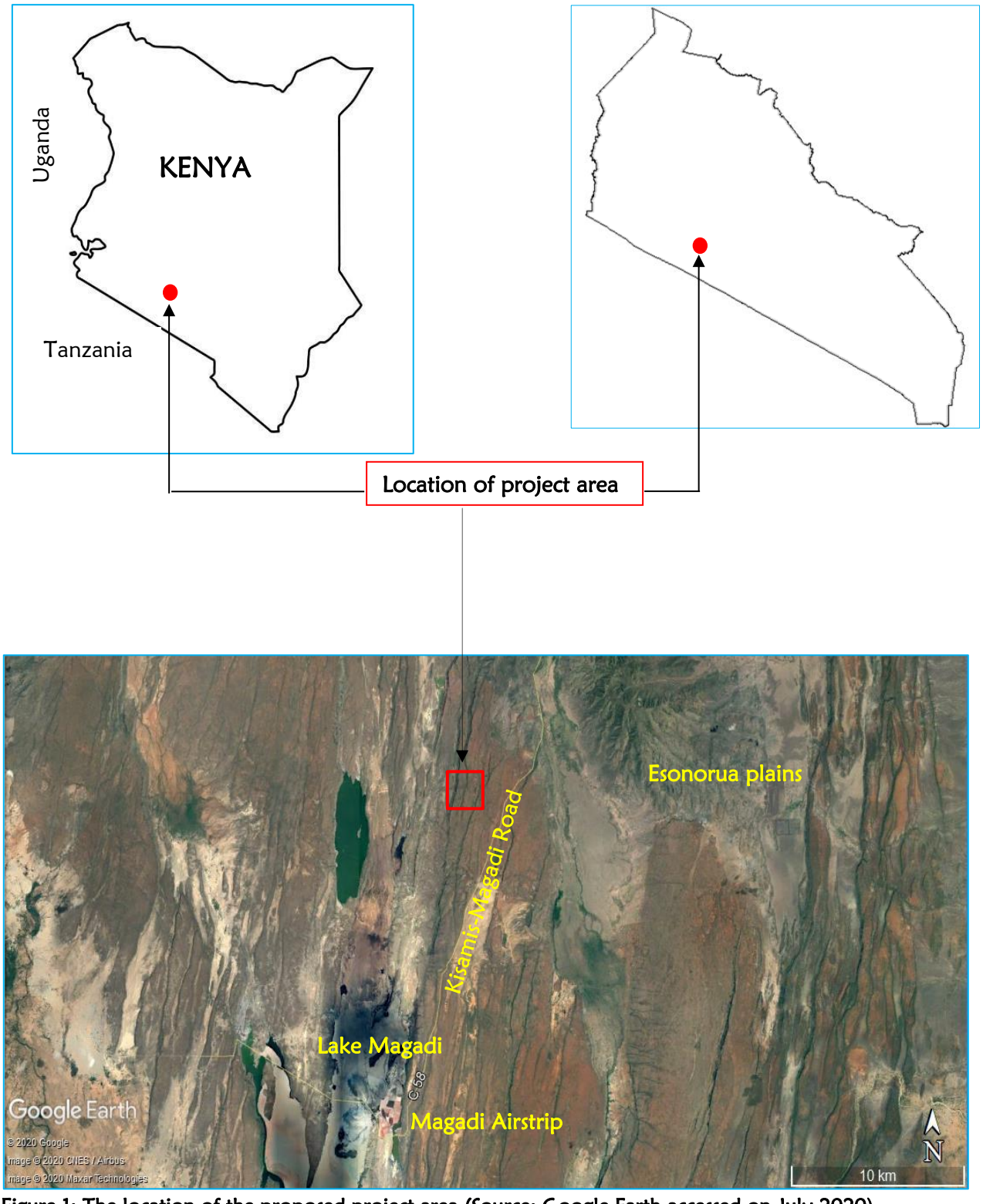

Figure 1: The location of the proposed project area (Source: Google Earth accessed on July 2020).

1.3 Project description and activities

The proposed project will feature an open cast mine and auxiliary facilities such as access roads, power, water, site offices, sanitary facilities, generator room and explosive stores among others. Three main process will occur during mining i.e. blasting, loading and transportation of boulders to the crushers. 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 crushers.

At the crushers, 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. The average production per day is estimated at 700 tonnes.

Once the aggregate deposits in the quarries are exhausted, the quarry pits created will be used as landfills for waste disposal.

1.3.1 Proposed project activities

The project activities will include;

- Clearing of 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
- blasting will be undertaken for the purposes of breaking rock boulders into acceptable sizes
- Crushing of boulders
- Transportation to various areas

1.4 ESIA study approach and methodology

1.4.1 Introduction

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. The consultants prepared a scoping report and Terms of Reference (TORs) as required under Regulation 11 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 and submitted them to NEMA for consideration for approval. The scoping report and TORs were approved on 5th August, 2020 and the consultants began preparation of the ESIA Study Report.

1.4.2 Data collection

The methods for carrying out the study included site visits and observations, literature review of relevant documents and baseline monitoring of environmental media (air, noise and soil).

Site visits were undertaken in July 2020 for purposes of area reconnaissance, assessing the baseline environmental conditions of the proposed project site and screening of environmental risks associated with the proposed development as well as the applicable environmental safeguards and standards. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. As per this schedule, the issues considered by the experts included ecological impacts, socio-economic issues, landscape changes, land use character and water (Table 1).

Table 1: Summary of results of the screening criteria.

Criteria	Results
Ecological impacts	– Excavations will occur – No endangered species of trees and plants found at the site
Social-economic considerations	– The project compliments governments efforts to attain the social pillar associated with development i.e. Vision 2030 – No cultural or heritage issues at the site – Project will lead to influx of migrants into the area and this may change social structure and behavior of local community – Project will engage in CSR activities – Income to the proponent – Employment creation – Revenue to the government through taxes & licenses
Landscape impacts	– The landscape of the area will be altered significantly
Land uses	– Land use is subsistence agriculture and livestock keeping
Water	– The establishment and subsequent operations of the proposed project will increase water demand and impact on water resources

1.4.3 Baseline monitoring of environmental media

The proposed development will generate dust and noise pollution during the establishment phase. In addition, there will be marginal increase in water demand and effluent generation during the establishment and operational phases. For the purposes of obtaining the baseline environmental quality conditions for future monitoring of the environmental performance of the proposal, the consultants engaged Polucon Services (K) Limited, to sample and analyse environmental media which included air, noise and soil as per the Environmental Management and Coordination Act Regulations. The methodology for sampling and analysis of the environmental media is discussed in the following sections.

1.4.3.1 Ambient air quality measurements

A Fixed-Point monitoring strategy was used to obtain baseline ambient air quality for the proposed project site which was conducted in August 2020. Air monitoring was conducted in two runs each 30 minutes and the averages for the measurements of Carbon Monoxide, Nitrogen dioxide, Sulfur dioxide and particulate matter (dust particles).

Sampling of gases was done by use of Aeroqual portable air monitors (Figure 2) which uses a mix of sensor technologies. Sampling for Carbon Monoxide, Nitrogen dioxide, Hydrogen sulphide, Sulfur dioxide was done using the gas sensitive electrochemical methods of active and continuous sampling. Particulate suspended matter was sampled using the laser particle sensors. The results interpretation and analysis as well as sampling duration information was used to calculate the gases concentrations. The results were compared to Environmental Management and Coordination (Air Quality) Regulations, 2014 and the WHO Air quality guidelines, Global update 2005; WHO Ambient Air Quality guidelines.

Figure 2: A portable Seroquel series 500 used in obtaining baseline air quality measurements at the proposed project site.

1.4.3.2 Ambient noise level measurements

Ambient noise measurements were conducted in August, 2020. Prior to recording the noise measurements, an inspection of the monitoring points and implicated activities of the area was undertaken, perimeter walls was identified and noise level meter calibrated. Noise levels were determined by the noise level meter (Figure 3), with an inbuilt, ϖoctave/octave band filter which does real time and octave analysis. The noise level meter was raised 2 meters above the ground and fitted with a ½" electrets condenser microphone with a measurement range of between 30 – 130dB and a frequency range and weighting of 25Hz – 10KHz and A, C & Z respectively. For all measurements taken to establish the ambient noise levels, the equivalent noise level (Laeq), the maximum sound level (Lmax) and the minimum sound level (Lmin) respectively during that measurement period was at one hour interval. Each individual measurement was taken simultaneously with the nature of the noise climate of the area. This involved an auditory observation and identification of noise incidents influencing the noise level meter readings by the surveyor.

Figure 3: Noise level meter TES 1358 C used in obtaining baseline noise levels at the proposed project site.

1.4.3.3 Soil analysis

A soil sample was obtained at the project site and analyzed for heavy metals. The purpose of soil sampling was to give a general indication of existing potential contaminants and for future monitoring of the impact of the project.

1.4.3.4 Biodiversity survey

The selection of transects was based on the topography and aspect as this has a bearing landscape feature and exposure to sunlight, respectively. The features identifiable from the reconnaissance included rocky zones and thick scrubland. The aerial view of the site photo also guided in the general typology of the vegetation types. Use of roads as bird observation transects was to allow for navigability.

1.4.3.4.1 Transect walks

Transects were used in the flora and habitat survey, bird survey and the reptile/amphibian study. This involved preliminary survey of the study area (predetermined transect locations) and adjusting on transect orientation based on topography and physical characteristics in order to capture comprehensive data.

1.4.3.4.2 Fixed Radius Method

This was used to collect data in birds in addition to the transect method.

1.4.3.4.3 Visual Encounter Method

To evaluate the status of reptiles and amphibian populations within the project area, visual encounter surveys were conducted. Surveys were conducted utilizing a randomized-walk design. The observer chose at random a sequential series of compass directions and a random number of meters to be walked in each selected direction. All reptile and amphibian observed within 1 meter on either side of the path were recorded.

1.4.3.4.4 Interviews

Local community members, project site users and specialized informants were identified for the purpose of interviews. Targeted information on the interviews was on the historical and current perspective of biodiversity composition (habitats typologies and fauna).

1.4.3.4.5 Desktop review

The desktop review relied on Arid and Semi-Arid Lands (ASAL) research areas which are similar in habitat typology to the proposed project site

1.5 Project budget

The total estimated cost of the proposed project is KES 20,000,000.

2 BASELINE CONDITIONS OF THE PROPOSED PROJECT SITE

2.1 Introduction

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. The baseline survey was done through literature review, site visits and baseline environmental quality monitoring in collaboration with Polucon Services (K) Limited. 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.

2.2 Site status

The proposed project site is currently undeveloped. The area is covered with thorny bushes and rocky outcrops (Figure 4). There is evidence of horticultural practices next to the proposed site used as a grazing zone.

Figure 4: Sections of the proposed project site (Source: Site Visit, July 2020).

2.3 Demographic characteristics

According to the 2019 population census, Kajiado County was found to have a total population of 1,117,840 people with 557,098 being male and 560,098 females. The county covers a total area of approximately 21,871 Km^2 and a population density of 51 people per square kilometer. The Maasai form the bulk of the population but other ethnic groups such as the Kamba and Kikuyu have infiltrated the area.

2.4 Topography, geology and soils

The main physical features in Kajiado County are plains, valleys and occasional volcanic hills from an altitude of 500 metres above sea level at Lake Magadi to 2500 metres above sea level in Ngong Hills. The proposed site lies within the Esonorua plains which has an undulating topography punctuated by rocky hills (Figures 5and 6).

The geology of the area is characterized by phonolites and basement system rocks quite stony and rather shallow, hence the suitability of quarrying activity. The soils are basically of the sediment type and are composed of sediment from tertiary volcanic rocks washed down from the eastern slopes of the Rift Valley escarpments. Soils also vary from dark reddish brown sandy and clay usually covered by anthills (Figure 7). Normally, they are of medium potential thus support crop and livestock.

Figure 5: A rock hill punctuating the proposed project site (Source: Site Visit, July 2020).

Figure 6: A section of the proposed project site showing rocky outcrops (Source: Site Visit, July 2020).

Figure 7: Soils at the project site covered by anthills (Source: Site Visit, July 2020).

2.5 Climate and vegetation cover

Kajiado County experiences a bi-modal rainfall pattern. Short rains are experienced between October and December whereas long rains are between March and May. Temperatures vary with altitude and season with the highest recorded temperature being 34°C. The coolest period is between July and August whereas the hottest period is between November and April (Figure 8).

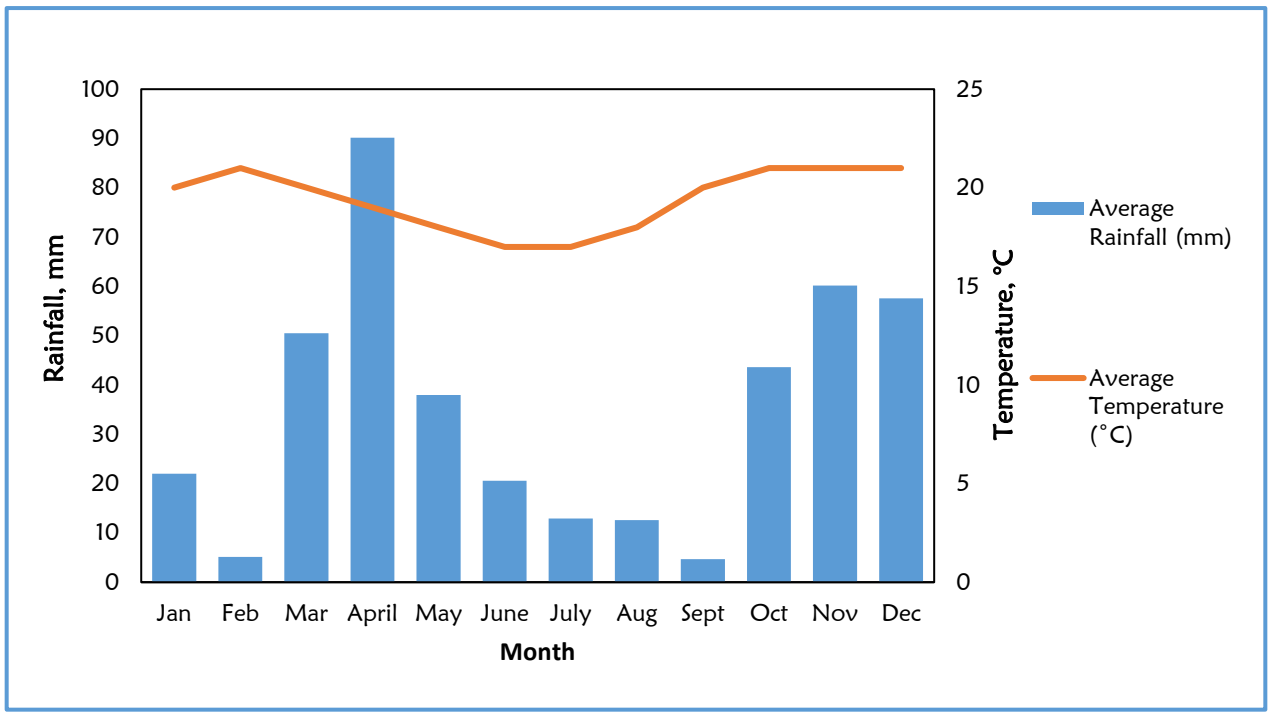

Figure 8: Annual rainfall and temperature distribution for Kajiado County in 2019 (Data Source: World Weather Online).

2.6 Flora and fauna

Esonorua area lies in a semi-arid zone. The ecological zone contains a rich diversity of flora and fauna with some species being endemic to either Kenya or the Flora of Tropical East Africa. Predominant flora in the area are dry land trees and scrubland. Some of the identified tree species included *Acacia cavens*, *Acacia longifolia*, *Acacia tortilis* and *Senegali gregii.* The dominant grass species was *Sporobolus airoides (*Figure 9). Predominant fauna in this area include birds such as *Spreo superibus*, *Dioptropnis fischeri*, *Lagonosticta senegala and Steptopelia capicola (*Figure 10). The insects include butterflies and beetles.

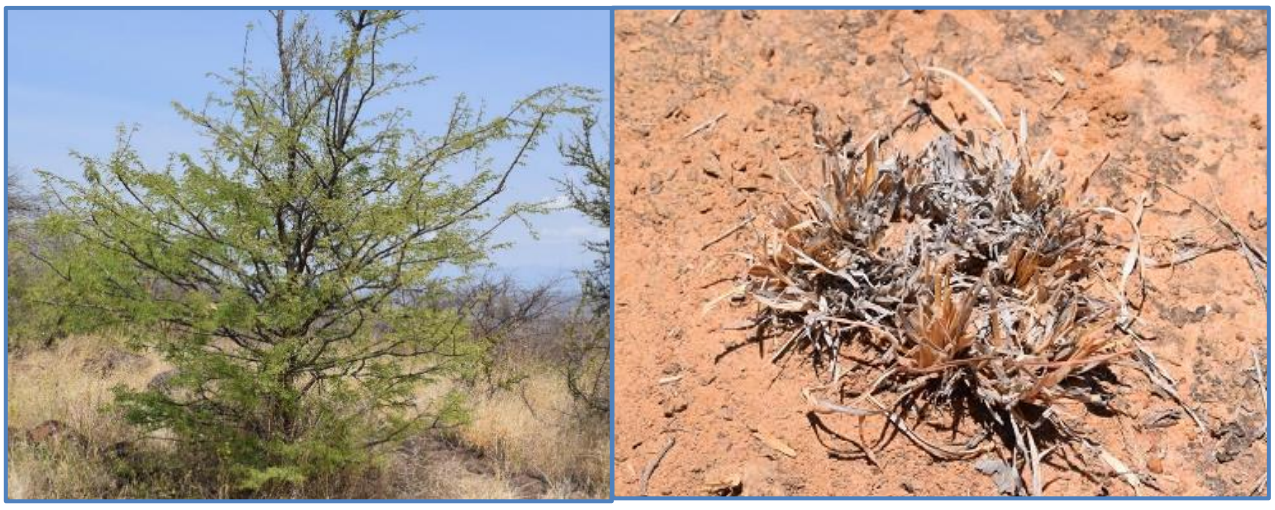

Figure 9: *Acacia caven spp* (Left) and *Cenchrus spp* (Right) found within the project site (Source: Site visit, July 2020).

Figure 10: *Spreo superibus* (Superb Streling)(Left) and *Pogoniulus chrysoconus* (Yellow Fronted T.)(Right) found within the project site (Source: Site visit, July 2020).

2.7 Land use patterns and socio-economic activities

Land use patterns in Esonorua area feature nomadic pastoralism and livestock rearing. The bulk of the population in the area practice nomadic pastoralism owing to the dry weather conditions. The main livestock types reared include goats and sheep (Figure 11). Subsistence agriculture is carried out in small areas by only non-indigenous people in the southern and western parts of the County along rivers and springs (Figure 12). There is a significant change in land use in the urban areas where industrial and commercial use is gaining momentum.

Figure 11: The types of livestock present at the proposed site (Source: Site visit, July 2020).

Figure 12: A horticulture farm near the project site (Source: Site visit, July 2020).

2.8 Water resources and local hydrogeology

The area is water stressed thus the local population is dependent on boreholes and springs from nearby plateaus. It also has perennial and seasonal streams owing to low precipitation and high evaporation rates. Generally, water tables are low owing to the porous nature of rocks that allow water seepage to low ground levels. Boreholes are drilled to a depth of about 175-250m and the quality of water from the boreholes is good (fluoride and dissolved compounds level is low) hence suitable for consumption. Notably, the quarry will exert high demand for water resources and it was therefore imperative for the study to assess water availability within the proposed project area.

A hydrogeological survey carried out in the neighbouring area of the proposed project site indicated that groundwater bearing formation is expected within weathered/porous or fractured phonolites.

2.9 Communication and Infrastructure

Part of Kajiado County is well served by all- weather roads and good telecommunication network as well as electricity. The road leading to the site is narrow and almost impassable. Some sections of the road are dilapidated while others are overgrown with thorny bushes. The area where the proposed project site is located is connected to the national grid thus the proponent will apply to Kenya Power for connection.

There are no social or otherwise sensitive institutions like schools within the project site.

2.10 Baseline air quality measurements

The gaseous and particulate matter parameters tested at Emet Limited showed compliance with the Environmental Management and Coordination (Air Quality) Regulations, 2014. (Table 2).

Table 2: Baseline air quality measurements for the proposed project site (Source: Polucon Services (K) Limited, August 2020).

Location		CO mg/m³	NO_2 µg/m³	SO_2 µg/m³	H2S	$PM_{2.5}$ µg/m³	PM_{10} µg/m³
Emet Limited <	Run 1	<0.05	0.22	<0.04	<0.04	53	94.5
	Run 2	<0.05	0.27	<0.04	<0.04	53	98.6
	Run 3	<0.05	0.18	<0.04	<0.04	52	98.4
Average		<0.05	0.2233	<0.04	<0.04	52.667	97.167
EMCA (Air Quality) Regulations, 2014		4 mg/m³	4 mg/m³	500µg /m³	150 µg//m³	75 µg/m³	100 µg/Nm³

2.11 Baseline noise level measurements

Ambient noise levels at the time of monitoring were slightly higher than the stipulated standards under the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009. This was attributed to the prevailing windy conditions at the time of monitoring. However, the ambient noise levels complied with the WHO, World Bank and OSH standards (Table 3).

Table 3: Baseline Noise monitoring measurements for the proposed project site (Source: Polucon Services (K) Limited, August 2020).

Location	Measured Sound levels (dBA) Day time			EMCA Guidelines (Day time)	World Bank (Day time)	World Health Organization (Day time)	Occupational Safety and Health Exposure Limits
	Laeq	Lmax	Lmin	Laeq	Laeq	Laeq	Laeq
Emet Limited	58.7	81.8	30.8	60	70	85	90
	57.9	79.6	30.1	60	70	85	90
	58.2	80.9	30.6	60	70	85	90

2.12 Soil analysis

A soil sample was obtained at the project site and analyzed for heavy metals. The purpose of soil sampling is to give a general indication of existing potential contaminants and for future monitoring of the impact of the project (Table 4).

Table 4: Baseline soil analysis for the project site (Source: Polucon Services (K) Limited, August 2020).

Tests	Test method	Results	Units
Copper as Cu	EPA 3051A	1.11	mg/kg
Lead as Pb	EPA 3051A	<0.01	mg/kg
Chromium as Cr	EPA 3051A	0.36	mg/kg
Mercury as Hg	EPA 3051A	<0.001	mg/kg
Zinc as Zn	EPA 3051A	3.06	mg/kg
Cadmium as Cd	EPA 3051A	<0.01	mg/kg
Iron as Fe	EPA 3051A	2.04	mg/kg

3 ENVIRONMENTAL IMPACTS IDENTIFICATION AND PROPOSED MITIGATION MEASURES

3.1 Overview

The proposed project will have both socio-economic benefits and attendant negative environmental and social impacts. The purpose of the ESIA process is to therefore 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 EIA that everyone is entitled to a clean and healthy environment and a duty to enhance and safeguard the environment.

3.2 Positive impacts of the proposed aggregate quarry

The project's direct benefits include but are not limited to the following;

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.

2. Mitigating national and regional demand for aggregates

As Kenya strives for industrial and economic development, there is a corresponding increase in construction activities which has translated to high demands of construction materials such as aggregates. According to the Kenya National Bureau of Statistics, the nation's construction industry registered accelerated growth of 13.1% last year compared to 5.8% in 2013. The establishment of the quarry will increase production of aggregate which will help mitigate the spike in national and regional demand for aggregates.

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 improving the living standards of the local population and the immediate environs.

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. Source of income to the proponent

The proposed facility through its operations will accrue income to the proponent enabling expansion of business and creating more employment opportunities for Kenyans.

3.3 Negative impacts of the proposed project

Alongside the positive impacts, the proposed project is expected to have several social and environmental impacts at the different phases of the project cycle.

3.3.1 Pre-establishment and establishment phase impacts of the proposed aggregate quarry

3.3.1.1 Change in land use

The area where the proposed project site lies is currently used as a grazing zone by the pastoral community. Other neighbouring areas practice commercial ranching and horticultural activities. However, the proponent proposes to set up an aggregate quarry which is inconsistent with the current land use.

Recommended mitigation measure

1. Apply for and obtain a change of user from the County Government of Kajiado

3.3.1.2 Inaccessibility of project site

The proposed project site is located approximately 7.5 km from the main road. The road leading to the site is narrow and almost impassable. Some sections of the road are dilapidated while others are overgrown with thorny bushes.

Recommended mitigation measures

1. Widen the access road to the project site to improve accessibility
2. Grade the dilapidated sections of the access road
3. Erect traffic warning signages and observe speed limits of 20km/hr

3.3.1.3 Loss of arable land and grazing areas

The local community within the project area practices pastoralism and subsistence farming mainly horticultural crops such as vegetables. They also keep livestock mainly sheep and goats. The farmlands and grazing areas are important sources of livelihoods for the local community. Through implementation of project, the area will have to be fenced off resulting to loss of the grazing areas and farmlands and is therefore technically a threat to food security.

Recommended mitigation measure

1. The proponent will drill boreholes for the local community as CSR to compensate for the loss

3.3.1.4 Environmental risks of obtaining raw materials

The construction and installation of auxiliary facilities such as offices and sanitary facilities will require raw materials including building blocks, sand, aggregates, steel, cement, timber, paint etc. The construction industry accounts for a vast majority of the raw materials consumed in Kenya. This enormous consumption rate, nearly two billion metric tons per year, poses a major environmental challenge because of the limited supply of natural resources on hand. The extraction and use of natural resources has significant potential impact on the environment. Non-metallic minerals such as sand, gravel, limestone and crushed rock account for more than half of total materials consumed today. These volumes are expected to grow exponentially by 2060.

The extraction and production of metals has significant impacts in areas like acidification, air and water pollution, climate change, energy demand, human health and toxicity of water and land. The extraction and burning of fossil fuels and the production of iron, steel and building materials are already major contributors to air pollution and greenhouse gas emissions.

Recommended mitigation measures

1. Source raw materials from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya
2. Have a procurement plan based on the Bill of Quantities prepared by a Quantity surveyor to avoid potential oversupply of materials and wastage

3. Sensitize personnel on wastage of construction materials. Remnants should be collected and recycled as much as practical

3.3.1.5 Occupational safety and health

Machinery operations and use of tools are likely to expose the workforce, visitors and the neighbors to safety and health risks such as falling objects, moving machinery or even falls. The establishment of the quarry facility which will involve vegetation clearance and removal of overburden will utilize heavy machinery thus exposing the workers, neighbors and visitors to the site to health and safety risks. In addition, from air pollution from dust generated during the establishment phase and noise pollution as a result of heavy machinery are likely to have health impacts to workers a. All these risks have a potential to cause injury, permanent disability or even death.

Recommended mitigation measures

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

3.3.1.6 Air pollution

Sources of air pollution during the establishment of the quarry, construction activities and installation of the crushing plant will result mainly from excavation works, mixing of aggregates and movement of vehicles carrying construction materials. If generated in large quantities, dust may present respiratory challenges, cause eye irritation or visual intrusion. This will potentially affect the workers, visitors to the project site and the neighbors if it is in excess of 100 $\mu g/m^3$.

Recommended mitigation measures

1. Install appropriate and adequate dust screens around the project site
2. Sprinkle water on the construction site and quarry area to suppress dust
3. Procure, provide and enforce the use of dust masks to workers and visitors to the project site
4. Designate speed limits and sensitize the drivers to observe them
5. Comply with the provisions of the Environmental Management and Coordination (Air Quality) Regulations, 2014

3.3.1.7 Noise pollution

The construction works, delivery of building materials by heavy trucks and the use of machinery including concrete mixers and metal grinders among others may lead to high levels of noise and vibration within the construction site and the surrounding areas. The noise levels produced may be above the stipulated EMCA limits and may lead to hearing impairments to the workers, visitors to the site and the neighbours. Construction sites located in areas such as the proposed project site can only emit noise levels of up to 75 dB(A) during the day and 65dB (A) at night as per the Second

Schedule of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

Recommended mitigation measures

1. Procure and provide adequate PPE such as earplugs to workers and visitors to the site
2. Service machinery and equipment regularly to ensure that they are in good condition
3. Sensitize truck drivers to avoid unnecessary hooting or running of vehicle engines
4. Comply with provisions of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

3.3.1.8 Water demand and effluent generation

At pre-establishment and establishment phase, water will be required for drinking, cleaning, dust management and sanitation purposes resulting in an increased demand for water. Since the area is water scarce, the proponent will drill a borehole. Based on a projected workforce of 30 people and the Population Equivalent (PE) which denotes that one-person resident is expected to produce 150 litres of effluent daily, approximately 4500 litres of effluent will be generated daily. The effluent needs to be disposed off appropriately to avoid pollution of surface and ground water aquifers.

Recommended mitigation measure

1. Obtain a permit for drilling and water abstraction from Water Resources Authority
2. Monitor the amount of water being abstracted from the borehole
3. Sensitize the workforce on the need to conserve the available water resources
4. 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
5. Procure and install a bio digester to manage the effluent in place of the septic tank-soak pit system
6. Comply with the Environmental Management and Coordination (Water Quality) Regulations, 2006

3.3.1.9 Solid waste generation

The solid waste generated at pre-establishment and establishment phase will be in form of biomass, overburden and domestic waste. There will also be construction waste in form of wood cuttings and reject metal pieces emanating from construction of auxiliary facilities. During this phase, about 30 workers may work at a time. If per capita waste generation is 300 gm per day, the quantity of domestic solid waste will be 9 Kg in a day. These will need to be disposed off appropriately as poor solid waste disposal can create breeding grounds for disease causing pathogens.

Recommended mitigation measures

1. Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the construction site
2. Reusing overburden as backfilling material during site rehabilitation and restoration
3. Create awareness on best waste management practices among the workers i.e. on the process of solid waste collection, segregation and proper disposal
4. Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste
5. Procure the services of a NEMA licensed waste handler to dispose the solid waste
6. Comply with the Environmental Management and Coordination (Waste Management) Regulations, 2006

3.3.2 Operational phase impacts of the proposed quarry facility

3.3.2.1 Land degradation

Quarrying involves complete clearance of vegetation, stripping of the topsoil and excavations to expose the underlying rock strata. The major vegetation cover of the project area are thorny bushes and grass owing to the climatic conditions of the area. Vegetation cover at the site provides several environmental and socio-economic benefits which include preventing soil erosion, carbon sequestration and provision of wood fuel to the local community hence clearance of the vegetation would lead to the loss of these benefits, tamper with the soil structure exposing the site to possible landslides and soil erosion. Additionally, quarrying 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 d pose a threat to human health and livestock.

Recommended mitigation measures

1. 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
2. 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

3.3.2.2 Occupational health and safety

Quarrying activities continue to hit the headlines regarding work-based accidents the most recent being fatalities in Kieni area of Nyeri County after quarry walls collapsed burying two alive. Vibrations and tremors from blasting activities can cause cracks on land and adjacent developments thus weakening them. These cracks can eventually widen causing collapse of buildings and landslides. Similarly, inhalation of airborne pollutants such as dust or exhaust fumes, high noise and vibration levels, injuries from use of equipment, falls and trips, as well as injuries from flying rocks from blasting activities all pose potential threats to the health and safety of workers on site and neighbours to the site. Abandoned and unrehabilitated quarry pits may also pose a threat to community health and safety as well as livestock as they may become breeding grounds for disease causing pathogens especially during the rainy seasons.

Recommended mitigation measures

1. Undertake a comprehensive geological survey of the area to determine slope stability
2. Develop and implement a safety and health policy at the workplace
3. Develop and implement an emergency response plan
4. Display signage warning of potential hazards at various sections of the quarry site
5. Provide adequate training to staff on health and safety
6. Provide and enforce the use of appropriate PPE among workers and visitors to the site
7. Provide a fully equipped first aid box, first aid services and emergency vehicle at the site
8. Provide the correct equipment to employees for the jobs assigned and trained on their use
9. Provide and keep an accident/ incident register
10. Conduct risk assessment audits annually and implement measures to reduce the risk posed to those working in and around the quarry facility
11. 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
12. Backfill the abandoned quarry areas to reduce the risks of accidents and potential of becoming breeding ground for disease causing pathogens
13. Ensure compliance with the provisions of the Occupational Safety and Health Act, 2007

3.3.2.3 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 and chemical vapors. The noise and vibrations emanating from blasting activities are also a health hazard. Blasting has in the past led to serious injuries and property damage from flying stones.

Recommended mitigation measures

1. Inform the local community prior to blasting
2. All loading and firing shall be directed and supervised by competent person(s) thoroughly experienced in this field and accredited accordingly
3. Employing qualified personnel to handle and store the explosives
4. Providing and enforcing the use of earmuffs to all workers and visitors to the facility
5. Increasing the number of delay detonators used in a round of blasting
6. Adhere to the provisions of the Explosives Act, 2012

3.3.2.4 Air pollution

Excavations, blasting, crushing and screening activities are the major sources of dust pollution in quarries. Moreover, transportation of the aggregates from the quarry site to the different areas using heavy machinery and heavy commercial vehicles is likely to cause dust bloom clouds. Dust pollution poses various health risks to its workers as well as to the surrounding communities including respiratory ailments, skin and eye problems, and safety issues due to poor visibility. The dust particle size, concentration, chemical composition and length of the exposure are factors considered in evaluating the health risks involved. Long-term severe exposure can pose the risk of developing silicosis, a fatal lung disease. Dust above $7gm^2$ on canopies has also been seen to impede plant development.

In addition, fumes and hydrocarbons produced by the heavy commercial vehicles and heavy machinery may lead to various respiratory complications.

Recommended mitigation measures

1. Adopt the wet crushing technology to minimize amount of dust generated during crushing of boulders
2. Sprinkle water at the quarry site and access road to suppress dust
3. Pave the entire facility to prevent dust emissions
4. Provide adequate dust masks to workers and enforce on their use
5. Retain the existing vegetation in areas which are not earmarked for quarrying to act as dust screens and a buffer zone between the quarry area and the settlements
6. 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
7. Comply with the Environmental Management and Coordination (Air Quality) Regulations, 2014
8. Comply with the provisions of the Occupational Safety and Health Act, 2007

3.3.2.5 Noise pollution

Quarrying involves several activities that may result into noise and excessive vibration. These are mainly from drilling, blasting, crushing, loading of aggregates, movement of HCVs and machinery operations. The noise levels and vibrations produced may be above the stipulated limits under the Third Schedule Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009. This may lead to hearing impairments to workers, visitors

to the site and neighbors, cause micro-cracks which eventually become mega cracks leading to landslides and weakening or collapse of nearby structures.

Recommended mitigation measures

1. Ensure that the vibration levels do not exceed 0.5 centimeters per second beyond the facility boundary wall
2. Increase the number of delay detonators used in a round of blasting so as to yield minimal ground vibrations and noise
3. Provide and enforce the use of earmuffs to all workers and visitors accessing noisy areas of the facility
4. Conduct noise monitoring in collaboration with a NEMA designated laboratory
5. Sensitize drivers to avoid running vehicle engines and hooting unnecessarily
6. Comply with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009
7. Comply with the provisions of the Occupational Safety and Health Act, 2007

3.3.2.6 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 rock 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. There are seasonal water streams that traverse the neighbouring area which have potential to be polluted by the quarrying activities. Surface water pollution can be caused by acid mine drainage and loading of sediment, debris and impurities from soil erosion or surface runoff.

Recommended mitigation measures

1. Undertake a hydrogeological survey to ensure that blasting and drilling are not undertaken to the water table level
2. In the event of flooding, water should 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
3. Secure the site with an impermeable boundary wall to ensure that the mining tailings and overburden are contained within the site
4. Maintain maximum existing vegetation coverage and plant more trees along the boundary wall to act as buffers

3.3.2.7 Water demand and effluent generation

At operational phase, water will be required for domestic use in drinking, sanitation and general cleaning. A bulk of the water used will be for dust suppression at the quarry area and the access road. This will exert marginal increase in demand for water estimated at 600litres per day. 70% of the domestic 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 off appropriately to avoid potential pollution of surface and ground water aquifers.

Recommended mitigation measures

1. Sensitize the staff on the need to conserve the available water
2. Install a bio-digester to manage effluent
3. Undertake quarterly monitoring of the quality of wastewater discharging from the bio-digester to ascertain compliance with legal standards

4. Apply for and obtain an Effluent Discharge Licence from NEMA pursuant to the Comply with the provisions of Environmental Management and Coordination (Water Quality) Regulations, 2006 after the EIA Licence
5. Comply with Environmental Management and Coordination (Water Quality) Regulations, 2006

3.3.2.8 Solid waste generation

The quarry 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 off appropriately. The proponent will therefore ensure proper management of solid waste during the operation of the quarry through the following measures.

Recommended mitigation measures

1. Sensitize new employees on solid waste management and its importance
2. Use the receptacles procured during the construction phase of the project cycle
3. Utilize the central collection bins procured during the construction phase of the project cycle
4. Implement the contractual agreements with the solid waste contractor procured at the construction phase
5. Re-use quarry waste and soil materials piled at the site to refill (restore) the excavated areas that exist as a result of mining
6. Comply with the Environmental Management and Coordination (Waste Management) Regulations, 2006

3.3.2.9 Energy demand

Quarrying of natural stone is an energy-intensive process. Overburden stripping, loading and hauling, crushing and screening, drilling and blasting are all quarrying processes that require energy either in form of electricity or petroleum. The facility will source its power from the National Grid.

Recommended mitigation measure

1. Maintain of machinery and equipment in a serviceable and good working order to maximize their efficiency on fuel
2. Keep records and analyze Kenya Power bills to identify areas of unnecessary use
3. Undertake energy audits every 3 years
4. Harness solar energy to be used for lighting purposes

3.3.2.10 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 which were not built for heavy use. To mitigate this impact the proponent and truck drivers will adhere to the axle load limits set by the Kenya Roads Board.

3.3.3 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. 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:

1. Creation of an ecologically vulnerable land

2. Economic decline
3. Insecurity
4. Safety and health risks
5. Waste generation

3.3.3.1 Creation of an ecologically vulnerable land

At this phase, destruction of various flora and fauna at the site is evident. Quarrying activities also have a direct impact on the land by leaving pits and heaps of waste material. Excavation, drilling and blasting will tamper with the soil structure exposing the site to possible landslides and soil erosion.

Recommended mitigation measures

1. Construct contour banks to protect disturbed areas from erosion prior to stabilization
2. Rip along the contoured slopes and immediate re-vegetation to increase slope stability
3. Promote re-vegetation through the encouragement of the natural process of secondary succession

3.3.3.2 Economic decline

Decommissioning of the proposed project will lead to loss of employment opportunities for the workers. In addition, the revenue earned by the County and National Government through levies and taxes will also be lost translating to economic decline. The proponent on the other hand will suffer the loss of investment.

Recommended mitigation measures

1. Train employees on alternative livelihoods prior to decommissioning
2. Pay terminal benefits to all employees
3. Comply with the Labor laws

3.3.3.3 Safety and health risks

Any remaining structures may collapse and the open pits may accumulate water overtime. There will be environmental hazards stemming from the exposed left-over substances which may cause soil and water contamination and/or generate noxious odor. Possible dust emission and accidents during rehabilitation of the site could also pose a health and safety hazard to workers and general public.

Recommended mitigation measures

1. Ensure the process of rehabilitation is supervised by competent personnel
2. Install signage to warn person(s) of the ongoing activities
3. Provide adequate and appropriate PPE and enforce their use
4. Ensure first aid kit are be available on site
5. Maintain the warning signs, fence and gate to prevent vandalism and interference of the site
6. Comply with the Occupational Safety and Health Act, 2007

3.3.3.4 Waste generation

Demolition of the auxiliary facilities will result in generation of solid waste. The solid waste will include demolition debris and metallic components. from the auxiliary facilities and will need to be disposed off appropriately. The demolition debris can be used in backfilling the decommissioned quarry pits. Effluent generated from decommissioning the biodigester will also need to be disposed off appropriately to avoid potential surface and ground water pollution.

Recommended mitigation measures

1. Contract a licensed construction company to carry out demolitions
2. Reuse and recycle demolition waste and equipment as far as practical
3. Contract a NEMA licensed waste handler to handle and dispose both solid waste and effluent generated

3.4 Impact identification, prediction and analysis

Potential project impacts are predicted and quantified to the extent possible. The magnitude of impacts on resources such as water and air or receptors such as people, communities, wildlife species and habitats is defined. Magnitude is a function of the following impact characteristics;

1. Type of impact (direct, indirect, induced)
2. Size, scale or intensity of impact
3. Nature of the change compared to baseline conditions (what is affected and how)
4. Geographical extent and distribution (e.g. local, regional, international)
5. Duration and/or frequency (e.g. temporary, short-term, long term, permanent)

Magnitude describes the actual change that is predicted to occur in the resource or receptor. The magnitude of an impact takes into account all the various impact characteristics in order to determine whether an impact is negligible or significant. Some impacts can result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact and are characterized as having a negligible magnitude (Table 5).

The levels of impacts are defined using the following terms

1. **Negligible impact (very low)-**Where a resource or receptor would not be affected by a particular activity or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background variations
2. **Less than significant impact (Low**) – Is a minor impact where a resource or receptor would experience a noticeable effect but the impact magnitude is sufficiently low (with or without mitigation) and /or the resource or receptor is of low sensitivity. In either case, a less than significant impact must be sufficiently below applicable standard threshold limits.
3. **Potentially significant impact (moderate)-**A moderate impact that meets applicable standards but comes near the threshold limit. The emphasis for such moderate impacts is to demonstrate that the impact has been reduced to a level that is as minor as reasonably practicable so that the impact does not exceed standard threshold limits.
4. **Significant impact (high) –** One where an applicable standard threshold limit would or could be exceeded, or if a highly valued or very scarce resource would be substantially affected.

Table 5: Risk and impact significance matrix for the proposed aggregate quarry

Environmental impact	Magnitude of impact at construction	Magnitude of impact at operation
Change in land use	0	2
Inaccessibility of the project site	2	0
Loss of arable land and grazing areas	2	2
Sourcing of raw materials	2	0
Occupational Safety and Health risks	2	3
Air pollution	2	3
Noise pollution	2	3
Water demand and effluent generation	2	2

Solid waste generation	2	2
Land degradation	2	2
Impacts of electric blasting	0	2
Ground and surface water pollution	0	2
Energy demand	1	2
Impacts of heavy trucks on roads	1	2

Legend

Magnitude	Impact score
Negligible	0
Low	1
Moderate	2
High	3

3.5 Public consultations and findings

3.5.1 COVID-19 and its risks to the stakeholder meetings

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, public consultation meetings could not be held in compliance with the Ministry of Health (MoH) guidelines on prevention of the spread of the virus.

Public consultations were however undertaken using informal interviews and questionnaires administered to the neighbors and stakeholders to collect and document their concerns regarding the construction and subsequent operation of the proposed project. In adherence to the health directive on COVID-19, a social distance of 1.5 meters between the interviewer and interviewee was observed, wearing of masks during the interviews and sanitization post interviews and where possible, the questionnaires were filled in by the interviewer. A total of 15 questionnaires were administered in August 2020. The main comments and proposed mitigation measures are summarized in tables 6 and 7 below.

Table 6: Summary of comments obtained from neighbors and stakeholders of the facility

No.	Respondents profile			Comments
	Name	Tel contact	ID No:	
1.	George Senva	0754063227	12491047	– Improvement of infrastructure – Will create employment – Will affect water catchment
2.	Lydia Moses	070141097	25109343	– Infrastructure improvement – Will provide enough drinking water – Will lead to air pollution – Workers are well provided with PPES
3	James P Kamukuru	0753601335	-	– Employment opportunities – Proximity of building materials – Roads will be redone
4	Naipana Sentu	0701521154	4476387	– Employment opportunities

5	Nasekuku Mbuha	-	723982	– Infrastructure improvement – Noise pollution
6	Teresa Natenya	-	34391129	– Improvement of infrastructure – Will create employment – No objection
7.	Joyce Kaimanyi	0716149150	28152814	– Improvement of infrastructure – Will create employment
8.	Maria Kollela	0707405500	26142815	– Revenue creation to government – Improvement of infrastructure – Will create employment – Air pollution – Noise pollution
9,	Mitchel Lemayian	-	34345129	– Improvement of infrastructure – Will create employment – Revenue creation to government – Noise pollution
10	Tito Okpojo		34281734	– Employment opportunities – Provision of building materials – Roads will be constructed – Job opportunities
11	Wilson Masai	0711152017	112823170	– Job opportunities – Improvement of infrastructure – Will create employment
12	Ole Simon	079815421	21345634	– Employment opportunities – Provision of building materials – Roads will be constructed
13.	Naimenyi diana		141141410	– Improvement of infrastructure – Employment opportunities – Provision of building materials – Roads will be constructed
14.	Samuel R. Nicholas	0710652028	22648018	– Employment opportunities – Roads will be constructed
15.	Samuel Natenya	0710171577	-	– Improvement of infrastructure – Employment opportunities – Provision of building materials
16.	Moses Olesepit James	0707642511		– Proximity of building materials – Improvement of infrastructure – Employment opportunities

Table 7: Issues raised by the local community and the recommended mitigation measures.

No.	Issues raised by the local community	Recommended mitigation measures
1.	Air pollution	• Adopt the wet crushing technology to minimize amount of dust generated during crushing of boulders • Sprinkle water at the quarry site and access road to suppress dust • Pave the entire facility to prevent dust emissions • Provide adequate dust masks to workers and enforce on their use • Retain the existing vegetation in areas which are not earmarked for quarrying 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 • Comply with the Environmental Management and Coordination (Air Quality) Regulations, 2014 • Comply with the provisions of the Occupational Safety and Health Act, 2007
2.	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 • Conduct noise monitoring in collaboration with a NEMA designated laboratory • Sensitize drivers to avoid running vehicle engines and hooting unnecessarily • Comply with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 • Comply with the provisions of the Occupational Safety and Health Act, 2007

3.6 Analysis of project alternatives

Analyzing project alternatives is important as it allows the proponent to evaluate possible project options that could mitigate the environmental risks identified during the ESIA process through prevention, elimination of the risks all together or reduction of the severity of an impact. The analysis will also assist NEMA and lead agencies in decision making by either approving the project as proposed or advising the proponent on the need for a particular alternative such as an alternative site. In the current proposal, the alternatives identified are discussed in detail below.

3.6.1 The 'No Project' alternative

Under this alternative the project will not be implemented and hence the status quo will be retained. This alternative represents the ideal mitigation measure for the negative environmental and social impacts as they will not occur as a result of the project. Conversely, the positive impacts of the project which include simulation of industrial development coherent with Kenya's Vision 2030, increased production of aggregate, creation of employment opportunities and revenue generation to the government will be lost. This alternative is therefore not viable.

3.6.2 The 'Yes Project' alternative

This alternative envisions that the proposed project will be implemented as proposed in its entirety. It is the best alternative in mitigating the potential loss of benefits to the proponent, the community and the Government of Kenya. In addition, the project will improve the development ranking of Esonorua area.

3.6.3 Alternative project site

An alternative site could be considered for the proposed aggregate quarry if the proposed project would present serious environmental challenges that cannot be reasonably be effectively managed. However, the proposed mitigation measures are considered adequate to minimize the impacts to levels that do not warrant significant environmental damage. Additionally, the proposed site is considered suitable as it has sufficient and substantial rock deposit quantities. Hence, this alternative is not considered viable.

3.6.4 Alternative project

An alternative project such as a farm or a ranch could be possible in the event an industrial development is not feasible. There is availability of adequate land approximately 100 hectares and substantial rock deposit quantities suitable for mining activities and this project is deemed economically viable compared to other project alternatives. Thus, an alternative project is not viable.

4 ENVIRONMENTAL MANAGEMENT PLAN

4.1 Introduction

The preceding section identified and analyzed the potential environmental and social impacts of the proposed project and proposed mitigation measures to address the impacts. Under this section, three Environmental Management Plans (EMPs) are proposed to guide the proponent in implementing the mitigation measures. These are EMPs for the establishment and construction, operational and decommissioning phases of the project. Each of the EMP is organized into five sections comprising of the environmental impact, the recommended mitigation measures, responsibility, timeframe and budget.

The approach for mitigation follows the precautionary principle which aims at first avoiding the impact, minimizing the impact by limiting the degree or magnitude of the action, rectifying the impact by repairing, rehabilitating, or restoring the affected environment, reducing or eliminating the impact over time and lastly compensating for the impact by replacing or providing substitute resources or environments.

4.2 Environmental Management Plan for the construction phase

For the construction phase EMP (Table 8), the main environmental issues include change in land use, inaccessibility of the project site, loss of arable land and grazing areas, environmental risks for obtaining raw materials, occupational safety and health risks, air and noise pollution, water demand and effluent generation and solid waste generation. The timeframe for implementation is considered to be time it will take for the proponent to complete the establishment and construction phase.

4.3 Environmental Management Plan for the operation phase

At the operational phase of the project (Table 8), major environmental concerns will include land degradation, occupational safety and health risks, impacts of electric blasting, air and noise pollution, ground and surface water pollution, solid waste generation, water demand and effluent generation, energy demand and impact of heavy trucks on roads.

4.4 Environmental Management Plan for the decommissioning phase

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 key issues at this phase will be creation of an ecologically vulnerable land, economic decline, insecurity, safety and health risks and waste generation (Table 8).

Table 8: Environmental Management plan for the establishment and construction, subsequent operation and possible decommissioning phase of the proposed project.

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
Establishment and Construction phase				
Change in land use	Apply for and obtain a change of user from the County Government of Kajiado and Ministry of Lands	Proponent	Prior to commencement	TBD
Inaccessibility of project site	Widen the access road to the project site to improve accessibility	Proponent/contractor	Prior to commencement	In project costs
	Grade the dilapidated sections of the access road	Proponent/contractor	Prior to commencement	Nil
	Erect traffic warning signage and observe speed limits of 20km/hr	Proponent/contractor	Prior to commencement	Nil
Loss of arable land and grazing areas	The proponent will drill boreholes for the local community as CSR to compensate for the loss	Proponent/contractor	During construction	Tender
Sourcing of raw materials	Source raw materials from sites that are licensed by NEMA	Proponent/contractor	During construction	Nil
	Have a procurement plan based on the Bill of Quantities	Proponent/contractor	During construction	Nil
	Sensitize personnel on wastage of construction materials	Proponent/contractor	During construction	Nil
Occupational safety and health risks	Register the site as a workplace with the DOSHS	Proponent/contractor	Prior to commencement	Nil
	Obtain insurance cover for the workers at the site	Proponent/contractor	Prior to commencement	1,000,000
	Procure and provide adequate and appropriate PPE to workers and visitors to the site and enforce on their use	Proponent/contractor	At construction	500,000
	Provide the correct equipment to employees for the jobs assigned and trained on their use	Proponent/contractor	During construction	Nil
	Secure moving parts of machines and sharp surfaces with guards to avoid unnecessary contacts and injuries	Proponent/contractor	Prior to commencement	Nil
	Provide a fully equipped first aid box, first aid services and emergency vehicle at the site	Proponent/contractor	During construction	500,000
	Comply with the provisions of the Occupational Safety and Health Act, 2007	Proponent/contractor	Throughout construction	Nil
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	20,000

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	Procure, provide and enforce the use of dust masks to workers and visitors to the project site	Proponent/contractor	Throughout construction	100,000
	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 to workers and visitors to the site	Proponent/contractor	Throughout construction	100,000
	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/ Truck drivers	During construction	Nil
	Comply with the Noise and Excessive Vibration Pollution (Control) Regulations, 2009	Proponent/contractor	Throughout construction	Nil
Water demand and effluent generation	Obtain a permit to drill and abstract water from WRA	Proponent/contractor	Prior to commencement	5,000
	Monitor the amount of water being abstracted from the borehole	Proponent/contractor	During construction	Nil
	Sensitize the workforce on the need to conserve the available water resources	Proponent/contractor	During construction	Nil
	Procure and deliver to the site mobile toilets from a NEMA licensed waste contractor for use by the workers	Proponent/contractor	Prior to commencement	200,000
	Comply with the Water Quality Regulations, 2006	Proponent/contractor	Throughout construction	Nil
Solid waste generation	Reuse the generated overburden in backfilling	Proponent/contractor	During construction	Nil
	Procure and provide adequate solid waste collection bins with a capacity for segregation	Proponent/contractor	Prior to commencement	100,000
	Create awareness on best waste management practices	Proponent/contractor	Throughout construction	Nil
	Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste	Proponent/contractor	Prior to commencement	200,000
	Procure the services of a NEMA licensed waste handler to dispose the solid waste	Proponent/contractor	Prior to commencement	Tender

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	Comply with the Waste Management Regulations, 2006	Proponent/contractor	Throughout construction	Nil
Operational phase				
Land degradation	Treat the quarry faces by initializing stabilization of the quarry pits walls through stepping of the faces to prevent erosion	Proponent	During operations	Nil
	Restore the affected areas through rehabilitation of decommissioned quarry pits and planting of indigenous plant species	Proponent	Upon decommissioning of each quarry pit	Nil
Occupational safety and health risks	Develop and implement a safety and health policy at the workplace	Proponent	Prior to operations	5,000
	Undertake a comprehensive geological survey	Proponent	Prior to operations	100,000
	Develop and implement an emergency response plan	Proponent	Prior to operations	Nil
	Display signage warning of potential hazards at various sections of the quarry site	Proponent	At operations	5,000
	Provide adequate training to staff on health and safety	Proponent	Biannually	20,000
	Provide and enforce the use of appropriate PPE among workers and visitors to the site	Proponent	Throughout operations	500,000
	Provide a fully equipped first aid box and first aid services within the facility	Proponent	During operations	30,000
	Provide the correct equipment to employees for the jobs assigned and trained on their use	Proponent	During operations	Nil
	Provide and keep an accident/ incident register	Proponent	During operations	1,000
	Conduct risk assessment and implement measures to reduce the risk posed to those working in and around the facility	Proponent	Annually	50,000
	Regulate access to the site by deploying adequate security measures and fencing	Proponent	At operations	Nil
	Backfill the quarried areas to reduce the risks of accidents and potential of becoming mosquitoes breeding grounds	Proponent	Upon decommissioning of each quarry pit	Nil
	Comply with the provisions of the Occupational Safety and Health Act, 2007	Proponent	Throughout operations	Nil
Impacts of electric	Inform the local community prior to blasting	Proponent	Throughout	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
blasting			operations	
	All loading and firing shall be directed and supervised by competent person(s)	Proponent	During operations	Nil
	Employ qualified personnel to handle and store the explosives	Proponent	Prior to operations	Nil
	Provide and enforce the use of earmuffs to all workers and visitors to the facility	Proponent	During operations	100,000
	Increase the number of delay detonators used in a round of blasting	Proponent	During operations	Nil
	Adhere to the provisions of the Explosives Act, 2012	Proponent	Throughout operations	Nil
Air pollution	Adopt the wet crushing technology to minimize amount of dust generated during crushing of boulders	Proponent	Prior to operations	TBD
	Sprinkle water at the quarry site and access road to suppress dust	Proponent	Daily	5,000
	Pave the entire facility to prevent dust emissions	Proponent	Prior to operations	In project costs
	Provide adequate dust masks to workers and enforce on their use	Proponent	During operations	100,000
	Retain the existing vegetation in areas which are not earmarked for quarrying	Proponent	During operations	Nil
	Develop and implement an air quality monitoring plan	Proponent/Designated NEMA Laboratory	Quarterly	30,000
	Comply with the Air Quality Regulations, 2014	Proponent	Throughout operations	Nil
	Comply with the provisions of the Occupational Safety and Health Act, 2007	Proponent	Throughout operations	Nil
Noise pollution	Ensure that the vibration levels do not exceed 0.5 centimeters per second beyond the facility boundary wall	Proponent	During operations	Nil
	Increase the number of delay detonators used in a round of blasting so as to yield minimal ground vibrations and noise	Proponent	During operations	Nil
	Provide and enforce the use of earmuffs to all workers and visitors accessing noisy areas of the facility	Proponent	During operations	100,000

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	Conduct noise monitoring in collaboration with a NEMA designated laboratory	Proponent	Quartely	30,000
	Sensitize drivers to avoid running vehicle engines and hooting unnecessarily	Proponent/Truck drivers	During operations	Nil
	Comply with the Noise and Excessive Vibration Pollution (Control) Regulations, 2009	Proponent	Throughout operations	Nil
	Comply with the provisions of the Occupational Safety and Health Act, 2007	Proponent	Throughout operations	Nil
Ground and surface water pollution	Undertake a hydrogeological survey to ensure that blasting and drilling are not undertaken to the water table level	Proponent/Contractor	Prior to operations	100,000
	In the event of flooding, water should be pumped out of the mines to avoid acid rock drainage and dissolution	Proponent	During rainy seasons	Nil
	Secure the site with a boundary wall to ensure that the mining tailings and overburden are contained within the site	Proponent	Prior to operations	In project costs
	Maintain maximum existing vegetation coverage and plant more trees along the boundary wall to act as buffers	Proponent	During operations	Nil
Water demand and effluent generation	Sensitize the staff on the need to conserve the available water	Proponent	During operations	Nil
	Install a bio-digester to manage the effluent generated	Proponent	Prior to operations	100,000
	Undertake monitoring of the quality of wastewater discharging from the bio-digester	Proponent	Quarterly	30,000
	Apply for and obtain an EDL from NEMA	Proponent	Annually	30,000
	Comply with the Water Quality Regulations, 2006	Proponent	Throughout operations	Nil
Solid waste generation	Sensitize new employees on solid waste management and its importance	Proponent	During operations	Nil
	Use the receptacles procured during the construction phase of the project cycle	Proponent	During operations	Nil
	Utilize the central collection bins procured during the construction phase of the project cycle	Proponent	During operations	Nil
	Implement the contractual agreements with the solid waste contractor procured at the construction phase	Proponent	During operations	Nil
	Re-use quarry waste and soil materials piled at the site to	Proponent	During operations	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	refill the excavated areas that exist as a result of mining			
	Comply with the Waste Management Regulations, 2006	Proponent	Throughout operations	Nil
Energy demand	Maintain machinery and equipment in a serviceable and good working order to maximize their efficiency on fuel	Proponent	During operations	Nil
	Keep records and analyze Kenya Power bills to identify areas of unnecessary use	Proponent	Monthly	Nil
	Undertake energy audits	Proponent	Every 3 years	100,000
	Harness solar energy	Proponent	At operations	Tender
Impact of heavy trucks on roads	The proponent and truck drivers will adhere to the axle load limits set by the Kenya Roads Board	Proponent/Truck drivers	During operations	Nil
Decommissioning phase				
Creation of ecologically vulnerable land	Construct contour banks to protect disturbed areas from erosion prior to stabilization	Proponent	Upon decommissioning	Nil
	Rip along the contoured slopes and immediate re-vegetation to increase slope stability	Proponent	Upon decommissioning	Nil
	Promote re-vegetation through the encouragement of the natural process of secondary succession	Proponent	Upon decommissioning	Nil
Economic decline	Train employees on alternative livelihoods prior to decommissioning	Proponent	3 months prior to decommissioning	Nil
	Prepare and issue recommendation letters to the workers to seek alternative employment opportunities	Proponent	Prior to decommissioning	Nil
	Comply with labor laws by paying the employees their terminal dues	Proponent	Prior to decommissioning	TBD
Safety and health risks	Ensure the process of rehabilitation is supervised by competent personnel	Proponent/Contractor	During decommissioning	Nil
	Install signage to forewarn people on ongoing demolition activities	Proponent/Contractor	During decommissioning	Nil
	Provide and enforce the use of PPE throughout the demolition works	Proponent/Contractor	Throughout decommissioning	50,000
	Avail first aid kits on site throughout the entire period	Proponent/Contractor	Throughout decommissioning	5,000

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	Comply with the Occupational Safety and Health Act, 2007	Proponent/Contractor	Throughout decommissioning	Nil
Waste generation	Contract a licensed construction company to carry out demolitions	Proponent/Contractor	Throughout decommissioning	5,000
	Recover re-usable materials for sale or use in other project sites	Proponent/Contractor	During decommissioning	Nil
	Contract a NEMA licensed waste handler to dispose off the demolition waste	Proponent/Contractor	Prior to decommissioning	Tender
	Comply with the Waste Management Regulations, 2006 and Water Quality Regulations, 2006	Proponent/Contractor	Throughout decommissioning	Nil

5 TYPICAL PROPOSED QUARRY REHABILITATION PLAN

5.1 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 topsoil over subsoil

5.2 Contouring the site

Landform reinstatement involves surface contouring to create a stable land formation consistent with the surrounding landform. 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.

5.3 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 Topsoil re-spreading

This involves the reapplication of topsoil accumulated from the original clearing. Topsoil 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

5.5 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 landform. 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 ENVIRONMENTAL MONITORING PLAN

6.1 Introduction

An Environmental Monitoring Plan is proposed to assist the proponent in mitigating possible adverse impacts arising from the proposed development and enhance the positive benefits arising from the project through implementation of the proposed mitigation measures. The purpose of the monitoring plan is to ensure that the impacts do not exceed legal standards specified under the different legislations. Implementation of the monitoring plans will ensure that the negative impacts of the project are lessened throughout the project cycle. For the proposed project, the following monitoring plans are proposed.

1. Health and safety monitoring plan
2. Air quality monitoring plan
3. Water quality monitoring plan
4. Solid waste monitoring plan
5. Noise monitoring plan
6. Rehabilitation and biodiversity monitoring plan
7. Energy monitoring plan

6.1.1 Health and safety monitoring plan

6.1.1.1 Introduction

Quarrying activities pose potential threats to the health and safety of workers and visitors. 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. During rainy seasons, abandoned quarry pits may become important breeding grounds for disease causing pathogens or lead to drowning in case of accidental falls. The purpose of health and safety monitoring plan is to assess existing controls alongside potential health and safety risks in order to develop an effective plan of action and to ensure compliance with Occupational Safety and Health Act, 2007.

6.1.1.2 Monitoring frequency

The responsibility for implementing this monitoring plan will vest in the Department of Occupational Safety and Health and overall the Management on an annual basis.

6.1.1.3 Monitoring strategy

The monitoring schedule will involve conducting occupational health and safety reviews and reports by the proponent, fire safety audits, energy audits among others that will be necessitated by operational activities of the quarry. There will be need for incidents register to document all occurrences, date, place, time, nature of incident, who was involved, action taken and preventive measures implemented throughout the year.

The ideal indicators of success will include zero accidents and fatalities and reduction in the number of incidents and accidents at the site.

6.1.2 Air quality monitoring plan

6.1.2.1 Introduction

Potential sources of air pollution at the project site are mainly dust from excavation activities, drilling and blasting. Other sources include emissions from machinery/ equipment and exhaust fumes from vehicles accessing the site and standby generator. Air pollution and emissions above the acceptable level can potentially cause health problems which include respiratory diseases and visual irritants. The purpose of the air quality monitoring plan is to therefore measure the concentrations of dust and gaseous emissions emanating from the project activities and the results compared to

the Air Quality Regulations, 2014 to ensure compliance. In addition, the results will be used to evaluate if the adopted air pollution controls and management are effective.

6.1.2.2 Monitoring parameters

The standard specified target values for the purpose of environmental monitoring and protection are stipulated in the First Schedule of the Air Quality Regulations, 2014 (Table 9).

Table 9: Ambient air quality tolerance limits as per the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014.

Pollutant	Time weighted average	Industrial area	Residential, Rural and other area	Controlled areas
Sulphur oxides (SO_x)	Annual Average*	80 µg/m³	60 µg/m³	15 µg/m³
	24 hours**	125 µg/m³	80 µg/m³	30 µg/m³
	Annual Average		0.019 ppm/50 µg/m³	
	Month Average			
	24 hours		0.048 ppm/125 µg/m³	
	One hour			
	Instant Peak			
	Instant Peak (10 min)		500 µg/m³	
Oxides of Nitrogen (NO_x)	Annual Average*	80 µg/m³	60 µg/m³	15 µg/m³
	24 hours	150 µg/m³	80 µg/m³	30 µg/m³
	8 hours			
	Annual Average		0.2 ppm	
	Month Average		0.3 ppm	
	24 hours		0.4 ppm	
	One hour		0.8 ppm	
	Instant Peak		1.4 ppm	
Nitrogen Dioxide	Annual Average	150 µg/m³	0.05 ppm	
	Month Average		0.08 ppm	
	24 hours	100 µg/m³	0.1 ppm	
	One Hour peak		0.2 ppm	
	Instant peak		0.5 ppm	
Suspended Particulate Matter (SPM)	Annual Average	360 µg/m³	140 µg/m³	70 µg/m³
	24 hours	500 µg/m³	200 µg/m³	100 µg/m³
	Annual Average ****		100 µg/m³	
	24 hours		180 µg/m³	
Respirable particulate matter (< 10µm) (RPM)	Annual Average*	70 µg/m³	50 µg/m³	50 µg/m³
	24 Hours**	150 µg/Nm³	150 µg/Nm³	75 µg/Nm³
PM 2.5	Annual Average	35 µg/m³		
	24 Hours	75 µg/m³		
Lead (Pb)	Annual Average*	1.0 µg/Nm³	0.75 µg/Nm³	0.50 µg/m³
	24 hours**	1.5 µg/m³	1.00 µg/m³	0.75 µg/m³
	Month Average		2.5	
Carbon monoxide/	8 hours	5.0 mg/m³	2.0 mg/m³	1.0 mg/m³
	One hour	10 mg/m³	4.0 mg/m³	2.0 mg/m³

Pollutant	Time weighted average	Industrial area	Residential, Rural and other area	Controlled areas
carbon dioxide				
Hydrogen Sulphide	24 hours**	150 $\mu g/m^3$		
Non methane hydrocarbons	Instant Peak	700ppb		
Total VOC	24 Hours**	600 $\mu g/m^3$		
Ozone	One hour	200 $\mu g/m^3$	0.12ppm	
	8 hour (Instant Peak)	120 $\mu g/m^3$	1.25ppm	

6.1.2.3 Monitoring location

Air quality monitoring will be conducted within the proposed project and areas in close proximity to the residential developments and other neighborhoods. These locations are considered to be sensitive receptors.

6.1.2.4 Monitoring frequency

Monitoring will be done on a quarterly basis in collaboration with a NEMA, DOSH or by a NEMA accredited laboratory.

6.1.2.5 Test equipment

The instruments to be used during Air Quality measurements should be similar to the one used during the baseline survey to ensure accuracy of inspection, measurements and results.

6.1.3 Noise monitoring plan

6.1.3.1 Introduction

Quarrying involves several activities 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. The purpose of noise monitoring plan is to therefore ascertaining the extent of the impact due to the establishment and subsequent operation of the proposed project in compliance with the Environmental Management and Coordination (Noise and Excessive Vibrations pollution) (control) Regulations, 2009. The results will be compared to the results that will be obtained during the baseline survey and the maximum permissible noise levels stipulated under the Environmental Management and Coordination (Noise and Excessive Vibration pollution) (control) Regulations, 2009 (Table 10).

Table 10: Maximum permissible noise levels (mines and quarries) as per the Environmental Management and Coordination (Noise and Excessive vibrations) Regulations, 2009.

Facility		Limit Value in dB (C) Max
1.	For any building used as a health facilities, educational institutions, convalescent home, old age home or residential building	109 dB (C)
2.	For any building in an areas used for residential and one or more of the following purposes: Commerce, small-scale production, entertainment, or any residential apartment in an area that is used for purpose of industry, commerce or small-scale production or any building used for the purposes of industry, commerce or small-scale production	114 dB (C)

6.1.3.2 Monitoring location
Noise level measurements shall be conducted at the same locations as for air quality monitoring.

6.1.3.3 Monitoring frequency
Monitoring will be done on a quarterly basis in collaboration with a NEMA, DOSH or by a NEMA accredited laboratory. Noise levels will be measured in dB (A).

6.1.3.4 Test equipment
The instruments to be used during noise measurements should be similar to the one used during the baseline survey to ensure accuracy of inspection, measurements and results.

6.1.4 Water quality monitoring plan
6.1.4.1 Introduction
The quarry will exert pressure on water for washing of vehicles and machinery, sanitation purposes, dust suppression and general housekeeping around the area. 70% of the domestic water use will be generated as effluent which will be managed through a bio-digester. The objective of the monitoring plan is to provide data and information to improve water quality and management of effluent and to comply with the standards prescribed by the Third Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006.

6.1.4.2 Monitoring parameters
The water quality parameters to be monitored and the corresponding values prescribed in the Water Quality Regulations, 2006 are shown below (Table 11).

Table 11: Water Quality Monitoring Parameters and the standards prescribed by the Environmental Management and Coordination (Water Quality) Regulations, 2006.

Parameter	EMC (Water Quality) Regulations, 2006 Standards
PH Value	6.5-8.5
BOD mg/L	30max
Chemical Oxygen Demand mg/L	50 max
Total Suspended Solids mg/L	30 max
Ammonia-NH+;mg/L	100 Max
Total Dissolved Solids mg/L	1200 Max
E. *Coli* Colonies count/100ml	Nil
Total coliform count/100ml	1000/100ml

6.1.4.3 Monitoring frequency
The frequency of monitoring will be quarterly. This will be implemented in collaboration with NEMA, DOSHS or by a NEMA accredited laboratory.

6.1.5 Solid waste monitoring plan
6.1.5.1 Introduction
Solid waste generation is likely to emanate from workforce at the site, construction activities and servicing of machinery, equipment and motor vehicles. Poor disposal of solid waste causes environmental pollution and therefore a health risk to communities. The purpose of the monitoring plan is to therefore ensure solid waste is managed in such a way that it protects both the public health and the environment.

6.1.5.2 Monitoring frequency

The frequency of solid waste monitoring will differ from the collection to the disposal stage in order to ensure reduced odours and accumulated heaps of waste. Table 12 describes the outline for which the activity will be monitored but can be adjusted depending on the amount generated.

Table 12: Sample outline for solid waste monitoring plan.

Parameter	Frequency	Critical levels (Tons)	Target	Responsibility
Collection	Daily			
Storage	Daily			
Management	Daily			
Disposal	Weekly			

6.1.5.3 Monitoring strategy

The solid waste monitoring plan will document the collection, storage and disposal of solid wastes from the quarry facility. There is need to code each of the collection points, note the capacity and critical levels, frequency of disposal and the personnel and contractor responsible. In addition, it will be important to characterize the waste streams at the collection points to inform investments in segregation infrastructure.

Indicators of success will include timely collection and disposal of wastes by the contractors, waste disposal tracking documents and certificates issued at the disposal sites in case of hazardous wastes.

6.1.6 Rehabilitation and biodiversity monitoring plan

6.1.6.1 Introduction

Quarrying activities will lead to creation of ecologically vulnerable land by tampering with the soil structure leaving pits and exposing the site to possible landslide and soil erosion, and destruction of various fauna and flora. A rehabilitation and biodiversity monitoring plan will ensure the site is restored to its near natural productive state and it will inform continual improvement of the ecological state after rehabilitation.

6.1.6.2 Monitoring frequency

The proponent will ensure monitoring is carried out annually.

6.1.6.3 Monitoring strategy

Monitoring will entail documenting on the flora and fauna species and ecological communities present at monitoring sites, monitoring of subsidence and erosion from areas re-profiled and rehabilitated and providing recommendations where necessary to enable continual improvement of the ecological management of the project area.

6.1.7 Energy monitoring plan

Energy consumption will be monitored through power bills from the Kenya Power and the fuel consumption by the standby generators and other machinery on a monthly basis. The quantitative audit findings will aim to inform substantial practical guidelines for continuous improvement of consumption efficiency and identifying cost saving opportunities in energy efficiency.

7 GOVERNANCE FRAMEWORK

The Third Schedule of EIA/EA Regulations requires that environmental guidelines and standards which include Kenya government policies and strategies, national legislation, multi-lateral environmental agreements and the institutional arrangements to render them should be incorporated in an EIA report. The legal and institutional frameworks provide important precautions for protection and conservation of the environment and ensuring community health and safety through compliance with the standards. Under this section, the EIA will therefore review the relevant sets of institutional, legislative and regulatory framework relevant to the proposed aggregate quarry.

7.1 Policy Framework

7.1.1 National Environment Policy

Kenya has a National Environment Policy prepared and approved in 2013 by the Ministry of Environment, Water and Natural Resources. Its overall goal is to provide better quality of life in Kenya for present and future generations through sustainable management and use of the environment and natural resources. This policy elaborates the effects of uncontrolled exploitation of minerals on the quality and health of the environment. It also encourages equitable exploitation and sound management of mineral resources while ensuring local participation and involvement of indigenous enterprises for investment in the mining sector.

7.1.2 The National Industrialization Policy

This policy is aligned to the Kenya Vision 2030 which aspires to transform Kenya into a middle income rapidly-industrializing country. This policy framework focuses on value addition for both primary and high valued goods and linkages between industrial sub-sectors and other productive sectors to drive the industrialization process. It aims at providing strategic direction for the sector growth and development.

7.1.3 Mining and Minerals policy

The mining and minerals policy's overall goal is to provide a clear guidance for sustainable mineral resources development and address existing gaps in the mining sector. It strengthens the institutional framework and addresses governance and operational issues, environmental protection, equity, mineral value addition, post-mine closure activities capacity building and mainstream artisanal and small-scale mining. The policy promotes the use of appropriate technology in order to enhance information on the country's mineral potential and increase investment in the mining sector.

7.2 Legislative Framework

7.2.1 The Constitution of Kenya, 2010

The Constitution of Kenya 2010 is the supreme law of the land. Under Chapter IV, article 42 provides for the right to a clean and healthy environment for all. Further, Chapter V of the Constitution deals with Land and Environment. Specifically, Part 2 elaborates on the obligations of the propone in respect to protection of the environment and enforcement of environmental rights.

Relevance to the proposed project

- The proponent should ensure that establishment and operations of the quarry do not infringe on the right to a clean and healthy environment for all.
- The proponent must ensure that the development is carried out in an ecologically, economically and socially sustainable manner.
- The proponent is entitled to a fair administrative decision-making process from NEMA and other State organs.

7.2.2 The Environmental Management and Co-ordination Act Cap. 387 of the laws of Kenya

The Act is the framework environmental law and aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with the National Environment Policy, 2013.

Relevance to the development proposal

Section 58 of the Act requires proponents of a development likely to have deleterious effects on the environment to prepare and submit an EIA report to NEMA for consideration for decision making. This report is prepared to comply with the provisions of this section. In addition, several Regulations have been enacted by the line Ministry to operationalize the Act as discussed below.

Regulations under the Environmental Management and Coordination Act Cap 387 Laws of Kenya

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 quarry.

7.2.3 The Mining Act, 2016

The mining Act makes provision for land set suitable for mining. This Act will guide the identification of land meant for mining and protects the ecologically fragile areas.

Relevance to the proposed project

Any person planning to carry out a mining activity should familiarize with the requirements spelt out in the Act and obtain authority from the Department of Mines and Geology to operate the quarry.

7.2.4 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.

Relevance to the proposed project

The proponent is obliged to comply with the provisions of this Act.

7.2.5 Public Health Act, 2012

The Act aims at prohibiting activities that may be injurious to the general public. It outlines the responsibilities for the County Government to maintain a safe and clean environment by controlling the development activities during the establishment and operation of proposed project.

Relevance to the proposed project

The proponent will ensure the safety of the public and its employees during establishment and operation of the proposed quarry.

7.2.6 The occupational Safety and Health Act, 2007

The OSHA 2007 commenced on 26th October 2007. It is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. Although the OSHA 2007 repealed the Factories and Other Places of Work Act, Cap 514 Laws of Kenya, it inherited all the subsidiary legislation issued under Cap 514. Examples of subsidiary legislation inherited include:

- Docks Rules L.N. 306 of 1962
- Eyes Protection Rules L.N. 44 of 1978
- Building Operations and Works of Engineering Construction Rules L.N. 40 of 1984
- Electric Power Special Rules L.N. 340 of 1979
- First Aid Rules L.N. 87 0f 1964
- Cellulose Solutions Rule L.N. 87 of 1964
- Health and Safety Committee Rules L.N. 31 of 2004
- Medical Examination Rules L.N. 24 of 2005
- Noise Prevention and Control Rules L.N. 25 0f 2005
- Fire Risk Reduction Rules L.N. 59 0f 2007
- Hazardous Substances Rules L.N. 60 of 2007

Relevance to the proposed project

Under OSHA, the proponent should provide the workers with appropriate PPE and enforce their use at work.

7.2.7 The Water Act, 2016

The Water Act provides the legal framework for sustainable utilization and management of water resources through an elaborate governance framework. It has four key institutions charged with separate functions and decentralized decision making systems. These institutions are summarized in the table 13 below.

Table 13: Water Resources Management Institutions and their roles as established under the Water Act, 2016.

Institution	Role
Water Service Boards (WSBs)	Development and maintenance of regional water provision infrastructure
Water Service Providers (WSPs)	Provision of reticulated supply
Water Resources Authority (WRA)	The Authority is responsible, among other things, for the issuance of permits for boreholes
Water Services Regulatory Board (WSRB)	License all providers of water and sewerage services who supply water services to more than twenty households

Relevance to the proposed project

The Water Act provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services. The proponent will obtain a permit from Water Resources Authority (WRA) for the drilling and abstraction of water from the borehole.

7.2.8 The Energy Act, 2006

The Act stipulates the electrical supply requirements one has to meet and offenses related to supply and use of electricity.

Relevance to the proposed project

The proponent is required to ensure that the energy supplied is consumed in accordance to the provisions of the Act and energy audits carried out annually.

7.2.9 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.

Relevance to the proposed project

The proponent will obtain pertinent approvals and requisite operational licenses from the County Government of Kajiado.

7.2.10 The Occupiers Liability Act Cap. 34

The Act regulates the duty that an occupier of premises owes to his visitors in respect of dangers due to the state of the premises or to things done or omitted to be done on them.

Relevance to the proposed project

The act requires that the occupier warn the visitors of the likelihood of dangers within his premises to enable the visitor to be reasonably safe.

7.2.11 The County Government Act, 2012

The new constitution grants County Governments the powers to grant or to renew business licenses or to refuse the same. To ensure implementation of the provisions of the new constitution, the County Governments are 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 general public.

Relevance to the proposed project

The Act gives right to access private property at all times by the County Government officers and servants for inspection purposes.

7.3 Institutional arrangements

To implement the above legal framework the government has established a number of institutions with varying mandates of implementation. These include;

1. The National Environment Management Authority (NEMA) to implement the Environmental Management and Coordination Act and associated Regulations.
2. The Mines and Geology Department to implement the Mining Act, the Explosives Act and minerals.
3. The Directorate of Occupational Safety and Health Services (DOSHS) to implement the Occupational Safety and Health Act alongside the subsidiary legislation.
4. The Water Resources Authority to implement the Water Act.
5. The County Government of Kajiado to implement the County Government Act, its by-laws and the Public Health Act.

8 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

The proposed project is considered important and beneficial as it has the advantage of optimal use of land, stimulation of industrial development coherent with Kenya's Vision 2030 and revenue generation to the government. Additionally, it will provide raw materials for construction and socio-economic benefits to the proponent and the residents of Esonorua area. However, there will be negative impacts at all phases of the project cycle. The main concerns include habitat degradation, pollution of environmental media and health and safety concerns.

These impacts are found mitigatable and hence the EIA proposes a comprehensive Environmental Management Plans and Monitoring plans to improve the environmental performance during the entire project cycle.

8.2 Recommendations

The main recommendation of the EIA is the need for concerted implementation of the EMP and Monitoring Plans by the proponent. These include;

1. Undertake a comprehensive geological survey to determine land stability
2. Register the site as a workplace with Directorate of Occupational Safety and Health Services
3. Install a bio-digester
4. Provide adequate and enforce the use of PPE
5. Procuring a sizeable central solid waste collection bin with chambers to accommodate separated wastes
6. All loading and firing of explosives to be directed and supervised by competent person(s)
7. Comply with the provisions of the Mining Act, 2016
8. Adhere to the provisions of the Explosives Act, 2012
6. Comply with Environmental Management and Coordination (Air Quality) Regulations, 2014
9. Comply with the provisions of the Occupational Safety and Health Act, 2007
10. Comply with the Environmental Management and Coordination (Water Quality) Regulations, 2006
11. Comply with the Environmental Management and Coordination (Waste Management) Regulations, 2006

On the basis of a commitment by the proponent to implement the proposed mitigation measures and the Environmental Management Plan, we recommend the issuance of an EIA License as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya and Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003.

9 REFERENCES

1. Government of Kenya Policies
    - National Environmental Policy
    - The National Industrialization Policy
    - Mining and Minerals Policy
2. Other relevant policies
    - Kenya Vision 2030
    - Sustainable development goals
3. Government of Kenya Statutes:
    - The Constitution of Kenya 2010
    - Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya
    - Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003
    - Environmental Management and Coordination (Air Quality) Regulations, 2014
    - Environmental Management and Coordination (Noise and excessive vibration) (Pollution) Regulations, 2009
    - Environmental Management and Coordination (Waste Management) Regulations, 2006
    - Environmental Management and Coordination (Water Quality Regulations, 2006
    - The County Government Act, 2012
    - The Explosives Act, 2012
    - The Mining Act, 2016
    - The Occupational Safety and Health Act, 2007
    - The Physical and Land use Planning Act, 2019
    - The Public Health Act, 2012
    - The Water Act, 2016
4. Documents provided by the proponent

10 LIST OF ANNEXTURES

1. Copy of certificate of lease for Emet Limited
2. Copy of Certificate of Incorporation for Emet Limited
3. Copy of PIN Certificate for Emet Limited
4. Copy of approval of the scoping report and Terms of Reference for the study
5. Copy of the baseline air quality and noise monitoring report
6. Copy of baseline soil sampling report
7. Copies of filled in questionnaires
8. Copy of NEMA practicing license for the firm, Envasses Environmental Consultants Limited
9. Copies of NEMA practicing licenses for Lead Experts, Mr. Simon Nzuki & Ms. Jane Gitau