Momnai Energy Ltd

Environmental, Social & Health Impact Assessment (ESHIA) for:

11 May 2022

Final Report

Solar PV Power Plant at Athi River, Machakos County

Main Report

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Signed:	
Date/Stamp:	**11 May 2022**

LIST OF ACRONYMS

ACC	Assistant County Commissioner
BD	Biological Diversity
BP	Bank Procedure
°C	Degrees Celsius
CBOs	Community Based Organisations
CSR	Cooperate Social Responsibility
DC	District Commissioner
DCC	Deputy County Commissioner
DDO	District Development Officer
DDP	District Development Plan
DEO	District Environment Officer
DO	District Officer
EMCA	Environmental Management and Coordination Act (1999)
EMP	Environmental Management Plan
ESHIA	Environmental, Social & Health Impact Assessment
GBV	Gender Based Violence
GHG	Green House Gas
GoK	Government of Kenya
Ha	Hectares
IRENA	International Renewable Energy Agency
KCAA	Kenya Civil Aviation Authority
Km	Kilometres
KMC	Kenya Meat Commission
kV	Kilo Volts
KWS	Kenya Wildlife Service
m	metres
M	Million
m asl	metres above sea level
Mm	millimetres
NEMA	National Environment Management Authority
OSHA	Occupational Safety and Health Act
PCM	Public Consultation Meeting
PDP	Part Development Plan
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
ROW	Right of Way
SEA	Sexual Exploitation and Abuse
STI	Sexually Transmitted Infection
TB	Tuberculosis
TOR	Terms of Reference
UNEP	United Nations Environment Programme
URTI	Upper Respiratory Tract Infection
UTI	Urinary Tract Infection
UTM	Universal Transverse Mercator
VAC	Violence Against Children
WRMA	Water Resources Management Authority
µS/cm	Micro siemens per Centimetre

PROJECT SUMMARY

Consulting Services for:	**Consultancy Services for carrying out Environmental, Social and Health Impact Assessment (ESHIA) Study for the Proposed 5MWac Solar PV Power Plant at Athi River, Machakos County**
Project Objectives	Momnai Energy Ltd intends to develop a Solar PV Power Plant (5MWac) in Athi River, Machakos County. Bamburi will provide land on sub-lease basis for the project for 25 years at its production site in Athi River. The Plant is located at its Nairobi Grinding Plant in Athi River, just off Mombasa Road. The connection will be made to Bamburi's existing sub-station at the Nairobi Grinding Plant in Athi River, Machakos County. Bamburi has entered into a Power Purchasing Agreement (PPA) with the project company. The plant will be located approximately 2 km away from the connection facilities. The Solar PV Power Plant and the Power Transmission Line will be confined within Bamburi Cement land.
ESHIA Study Objectives:	The main objective of the ESHIA Study is: To evaluate the Environmental and Social Impacts that will arise from the Proposed 5MWac Utility Solar PV Power Plant that will be installed near Bamburi Cement land in Athi River. The ESHIA Study is to; • Identify the Environmental, Social and Health Impacts of the proposed project. • Recommend appropriate and cost effective mitigation measures to address project impacts during construction and operation. • Generate baseline data for monitoring and evaluation of how well the mitigation measures will be implemented during the project cycle. • Evaluate and identify viable project alternatives • Prepare an Environmental, Social and Health Impact Assessment Study Report compliant with the Environmental Management and Coordination Act (1999) including the subsequent NEMA Regulations, IFC Performance Standards, World Bank Group EHS Guidelines, EIB Environmental and Social Standards and the ILO Conventions detailing Project Impacts, Project Alternatives, Proposed Mitigation Measures, Environment Management and Monitoring Plans and Decommissioning.
Client:	**Momnai Energy Ltd**
Consultants:	**PANAFCON Ltd**
Report Title:	**ESHIA Study –Final Main Report**
Submission Date:	**11 May 2022**

EXECUTIVE SUMMARY

E.1 INTRODUCTION

Momnai Energy Ltd intends to develop a Solar PV Power Plant (5MWac) at Athi River, Machakos County. Bamburi will provide the land on sub-lease basis for the project for 25 years at its production site in Athi River. The Plant will be located at its Nairobi Grinding Plant in Athi River, along the Old Nairobi-Mombasa Road. The power generated from the plant will be evacuated to an existing Substation facility located within the Grinding Plant approx. 2 Km south of the Solar Plant. The Solar PV Power Plant will be confined within Bamburi Cement PLC land.

The Solar PV Power Plant is being put up by Bamburi Cement Company to augment the electricity supplied by Kenya Power. The supply is inadequate as it is occasioned by frequent interruptions and rationing. This ESHIA Study Report has been carried out to address the environmental and social impacts that may arise during the development and operation of the solar power plant.

E1.1 Project Location

The proposed Solar PV Power Plant will be located at its Nairobi Grinding Plant in Athi River along the Old Nairobi-Mombasa Road. The Connection will be made to the existing Sub-station located within the Grinding Plant. The decimal coordinates of the Athi River Plant are -1.434850, 36.959833. The land lies at an altitude of approx. 1,500m above mean sea level.

The area is largely an industrial area with many factories including Bamburi Ready Mix Cement Factory, Poly Tanks and Containers Kenya Ltd, Ndovu Cement, SPA Industry, Exon Industries (Pty) Ltd, Euro Star Industrial Limited, Mold Plast Kenya Limited and Shalom Hospital.

E1.2 ESHIA Study Methodology

The ESHIA methodology followed a systematic process that predicted and evaluated the impacts the project could have on the physical, biological, social/ socio-economic and cultural environment, and identified measures that the Project will take to avoid, reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable. The study methodology comprised of the following activities:

- Preliminary Meetings;
- Desktop Review;
- Environmental Screening;
- Environmental Scoping;
- Stakeholder Engagement
  - ✓ Initial Stakeholder / Sensitization Meetings;
  - ✓ Public Consultation Meeting;
  - ✓ Public Disclosure Meeting.
- Environmental Baseline Data collection;
  - ✓ Site Evaluation and Collection of Biophysical Data
  - ✓ Soil Analysis;
  - ✓ Ambient Air Quality Assessment;
  - ✓ Ambient Noise Assessment.
- Ecological/Archaeological Assessment;
- Baseline Socio-Economic Studies;
- Data Evaluation, Analysis and Reporting

E2 PROJECT DESCRIPTION

The proposed project involves the setting up of a 5MWac solar power plant at Athi River in Mavoko Sub-County, Machakos County. The solar plant will use a total of 7,938 modules that will covers an area of approx. 35,457m^2 and it will use 50 inverters that will convert the DC current to AC with an operating voltage of between 600-1,500v. The Plant will use a total of 2 (2500kVA 6.6/0.4kV) Transformers. Detailed description of the project and components are provided in Chapter 2 of this report. The generated power will solely be used by Bamburi Cement PLC for its operations.

E3 LEGAL FRAMEWORK

The applicable frameworks that have been used in this study are:

a) National Guideline

- The applicable environmental and social regulations and policies in Kenya which include the Environmental Management and Coordination Act (EMCA) 1999 and the associated regulations.

  The proposed Solar Plant project is listed under the second schedule of section 58(4) of the Environmental Management and Coordination Act, 1999 (Rev, 2015) and Legal Notice No. 101 of June 2003 (Environmental Impact Assessment and Audit Regulations (Rev. 2019) as a project to be subjected to an Environmental Impact Assessment (EIA). It is categorized as medium risk project.

b) International Standards that include:

- Under the IFC Performance Standards (2012), the proposed project has minimal environmental and social impacts that will arise during construction and operation therefore falls under Category B of IFC PS1.

The applicable IFC Performance Standards used in the study

PS	Performance Standard	Remarks
PS1	Assessment and Management of Environmental and Social Risks and Impacts.	***Applicable*** There are Environmental and Social risks that will arise during construction
PS 2	Labour and Working Conditions	***Applicable*** The project is going to employ skilled and unskilled workers to offer services in the project and their welfare will need to be taken care of.
PS 3	Resource Efficiency and Pollution Prevention	***Applicable*** There are project activities like maintenance of vehicles and machines, fugitive dust and exhaust emissions that have the potential to cause pollution.
PS 4	Community Health, Safety, and Security	***Applicable*** Community members will be employed in the project. Project vehicles will also be transporting materials and waste outside the site exposing community members to safety risks
PS 5	Land Acquisition and Involuntary Resettlement	***Not Applicable*** There are no persons occupying the project land hence there will be no displacement
PS 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	***Applicable*** Although the project land has been degraded, flora and fauna exist
PS 7	Indigenous Peoples	***Not Applicable*** There are no indigenous peoples in the project as described in PS 5
PS 8	Cultural Heritage	***Not Applicable*** *The site was previously excavated for raw material. NMK have evaluated and confirmed non-existence of cultural heritage materials at the site. However, a "Chance Find Procedure" has been provided should the Contractor encounter anything of cultural importance.*

- EIB Environmental and Social Standards According to EIB Environmental and Social Standards, the project is listed under Annex II - Industry Energy that requires screening and development of necessary mitigation measures and therefore falls under Category B

The applicable EIB Environmental and Social Standards used in the study

Standards	Standard	Remarks
1	Environmental and Social Impacts and Risks	***Applicable*** ESHIA Study is being carried out to identify potential impacts for mitigation
2	Stakeholder Engagement	***Applicable*** There are stakeholders that need to be meaningfully consulted and engaged
3	Resource Efficiency and Pollution Prevention	***Applicable*** Project will use machines and vehicles that can impact soil and other resources
4	Biodiversity and Ecosystems	***Applicable.*** Although degraded, the site has flora and fauna hence there will be habitat loss and fragmentation of natural habitat
5	Climate Change	***Not Applicable*** The Solar PV Power Plant project is addressing climate change by endeavouring to reduce GHG
6	Involuntary Resettlement	***Not Applicable*** *There are no persons being displaced*
7	Vulnerable Groups, Indigenous Peoples and Gender	***Partially Applicable*** *The project area has gender issues*
8	Labour Rights	***Applicable*** The project will employ people and there is potential for labour influx. Worker's rights issues will arise
9	Health, Safety and Security	***Applicable*** There construction activities that will pose safety risks hence require assessment
10	Cultural Heritage	***Not Applicable*** *Site evaluation has been done and a no objection to proceed given. However, a "Chance Find Procedure" has been provided should the Contractor encounter anything of cultural importance.*

- The World Bank (WB) Group's Environmental, Health and Safety (EHS) Guidelines were also applied.

E.4 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

E4.1 The Physical Environment

The site falls within a highly disturbed grassed woodland dominated by several species of *Acacias*; mainly young *Acacia xanthophloea* (Fabaceae), *Schinus molle* (Anacardiaceae) planted on the periphery and invasive species. A small marsh area created by dumping of waste water near the Bamburi Special Products Plant creates a wetland microhabitat although very few wetland species were documented in the area. As a result of the human disturbance, the diversity of invasive species is high, with *Nicotiana glauca* (Solanaceae) dominating the soil mounts and other areas along the disturbance gradient within the site area. The site topography is highly uneven due to the past mining activities and soil stock piles.

E4.2 Climate

The Mavoko Sub County in Machakos County receives bimodal rainfall with short rains in October and December while the long rains from March to May. The rainfall range is between 500mm and 1250mm per annum. The temperatures vary between 18˚C and 29˚C throughout the year. The dry spells mainly occur from January to March and August to October.

E4.3 Topography
The elevation of the project area is approx..1,500m above sea level. The land surface is uneven due to past excavations and soil stockpiles.

E4.4 Geology and Soil
The geology of the area is characterized by a succession of lava and pyroclastics overlying a foundation of pre-Cambrian schists and gneisses of Mozambique belt. This region forms the eastern border zone of the rift valley which was associated with volcanicity. The proposed site is covered by black cotton soils, Athi tuffs and lake beds and Kapiti Phonolites that are underlain by gneisses and schists of Pre-Cambrian age.

The black cotton soils overly thin layers of sandy sediments and tuffs of Athi tuffs and lake beds which resulted from consolidation of fragmented volcanic material deposits.

E4.5 Baseline Data Collection and Analysis
In order to have baseline data for future monitoring purposes, on site measurements was carried out and additional samples were collected for laboratory analysis The results are provided in **Appendix 6,7 and 8.**

a) Soil
Soil samples were analyzed for Total Petroleum Hydrocarbons (TPH) and Heavy Metals [Lead (Pb), Nickel (Ni), Cadmium (Cd), Mercury (Hg), Chromium (Cr) and Lithium (Li)]. All the parameters analyzed were found to be within the limits contained in the National Environment Management Authority (NEMA) Environmental Inspection and Monitoring Manual (developed for petroleum industry) Document Revision Draft 2.0 Issued October 2020.

b) Ambient Air Quality
Air samples were analyzed for Particulate Matter (PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2). All the parameters analyzed were found to be within the limits contained in the Environmental Management and Coordination Act (Air Quality) Regulations 2014.

c) Ambient Noise Levels
The assessment was undertaken using a Larson Davis 870 precision integrating Sound Level Analyser with 902 pre-amplifier and integrated with a speed monitor. The noise level assessment undertaken at the proposed project site at Athi River has shown that the locations registered noise levels that complied with the maximum Occupational Exposure Levels (OEL) as contained in the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009.

d) Ecological Resources
Using standard methodology, a detailed field survey of different species of flora and fauna occurring in the site area was conducted. This included Plants, Mammals (bats, small & large mammals) Avifauna (birds), Herpetofauna (reptiles and amphibians) and Invertebrates. The proposed site for the construction of the Solar PV Power Plant in Athi River can be classified as 'Modified' following guidelines provided by IFC; which means the land has a large proportion of plant species that are of non-native origin, and/or human activity has substantially modified the area's primary ecological functions and species composition prior to the onset of a project.

The area is a small, highly degraded patch of land amidst factories, busy road and railway line. As such it holds low biodiversity, most of which does not trigger a critical habitat status under the IFC standards.

The detailed ecological study report is provided under **Appendix 11**.

e) Physical Cultural Resources

Archaeological and Cultural Heritage impact assessment has been undertaken to identify and ensure the protection of archaeological and cultural heritage assets associated with the project footprint area/sites to ensure that effective management and mitigation controls are in place. The field survey established that the proposed site is a currently used as a dumping site. The stratigraphy is disturbed hence very unlikely to contain any archaeological cultural heritage resources. No archaeological features were seen on the surface. There is no preservation of organic remains, such as fossil remains. The archaeological heritage resources documented are, overall, considered to be absent or if any of relatively low sensitivity due to the heavily disturbed nature of the site. The impact of this development on physical cultural heritage resources is expected to be minimal due to the secondary nature of deposits.

However, the absence of archaeological or cultural heritage materials on the surface may not preclude the possibility of their existence in secondary context especially those that may have been introduced from the damping materials in the ground. It is thus recommended that the developer immediately notifies the National Museums of Kenya (NMK) if any archaeological materials are detected/uncovered in the course of project preparing the site for operation. A Chance Finds Procedure (CFP) is provided under **Appendix 9** for this purpose.

f) Socio-economic Environment

The project is located in Mavoko Sub County which has a population of 322,498 (KNBS, 2019). A total of 49 socio-economic questionnaires were administered to the project area community, comprising mainly of casual workers from the surrounding industries and informal businesses. The project area is sparsely populated surrounded by large factories and the Nairobi National Park.

Majority of the population (65%) are engaged as casual labourers. The proposed Solar PV Power Plant will therefore enhance their mainstream economic activity by providing job opportunities as casuals and permanent employees. It is envisioned that the project will impact positively to their livelihoods.

E5 ANALYSIS OF PROJECT ALTERNATIVES

An analysis of "With" and "Without" Project scenario reveals that the positive impacts outnumbered the adverse impacts due to the proposed development. The adverse impacts are envisaged only during the construction phase which will be temporary in nature and of a short duration. Appropriate mitigation measures will be adopted to limit these adverse impacts during the construction phase. The proposed project will reduce dependence of fossil fuel for production of power resulting into considerable reduction in greenhouse gas emissions thereby reducing the carbon footprint. Solar power generation will alleviate day time interruption of electricity supply to the Grinding Plant.

E6 PUBLIC AND STAKEHOLDER CONSULTATIONS AND DISCLOSURE

Public consultations were carried out as an integral part of the social and environmental assessment process of the project with an objective to inform and educate stakeholders about the proposed actions and to receive and record public perceptions about the project. It assisted in identification of the likely issues and problems associated with the project as well as the needs and concerns of the population likely to be impacted. This participatory process helped in reducing the public concerns and enabling participation of the local people in this development process.

E6.1 Key Informants Interviews

Initial engagement with Key Stakeholders was done in November 2021. Further consultations were carried out in February 2022. Each Key Stakeholder was visited, briefed on the proposed project, before their views were sought through an interactive interview session. They were also provided with questionnaires. Outcome of the interviews are summarized in **Table 41**; The minutes and attendance registers are given under **Appendix 3**.

E6.2 Public Consultation Meeting

The Public discussion meeting was held on 9th February at Vocational Youth Centre Grounds, in Athi River, Mavoko Subcounty. The local community and relevant stakeholders including both government and private sector representatives participated in this meeting.

The meeting was attended by a total of 168 people (79 men and 89 female). The agenda, minutes of the meeting, list of participants and attendance sheets are provided as **Appendix 4** of this report.

E6.3 Public Disclosure Meeting

Project impacts disclosure meeting was carried out on Friday 22, April 2022. The meeting was convened to disclose the findings of the study and the project mitigation measures that will be carried out to mitigate the identified impacts. It also discussed the next steps in the project process. The key outcomes of the meeting were:

- The identified impacts can be managed through the mitigations provided in the ESMP;
- The community and the other stakeholders supported the implementation of the project.

The detailed outcome of the disclosure meeting is presented under **Appendix 5**.

E7 PROJECT IMPACTS AND MITIGATION MEASURES

The project has both positive and potential negative impacts. Detailed evaluation of the impacts and mitigation measures are provided in Chapter 7 of this Report. A summary of these impacts including enhancement measures for the positive impacts and mitigation measures for the negative impact are provided below.

E7.1 Positive Impacts

a) ***Climate Change Mitigation and Adaptation*** – The project will generate 5MWac of clean energy that will be used by Bamburi Cement Plant at Athi River. The proposed enhancement measure is to have the youth taking interest in enhancing their knowledge in the green energy sector. The project can impart skills and knowledge of the solar power technology to the youth through hands on engagement and training.

b) ***Improvement of Land Use*** **-** The site is currently a disused area that was excavated to provide raw materials for the Nairobi Grinding Plant. The middle section of the site is being used as a dumping site for refuse including highly hazardous materials like asbestos and medical waste which poses a significant risk to biodiversity and human health.
The proposed enhancement measure is to further improve the land by planting appropriate indigenous trees in open available spaces at the site and nurturing them to maturity. This will improve ambience and outlook of the project area.

c) ***Employment opportunities for Youth and Community*** **-** The project will provide job opportunities for the youth and members of the community. The proposed enhancement measures include preparing and implementing a gender plan to promote equity in job issuance and offer training opportunities and apprenticeships to males and females in Athi River area in order to enhance their skills.

d) ***Services to Solar Plant Workers*** - The workers at the solar plant will require various goods and services to be provided by the community members. Proposed enhancement measures include giving priority to Athi River community members to provide goods and services.

Such services should be on an arranged programme making the community members offering such services maximize benefits from their services.

e) ***Sourcing for Locally Available Materials*** **-** During construction, materials that will be used at the solar plant that are available locally shall be sourced locally for the development of the facility. Proposed enhancement measure includes offering opopportunity to supply building materials such as cement, sand and other small accessories and tools to Mavoko community members as first priority.

f) ***Generation of Clean Energy for Use by Bamburi Cement*** **-** By generating 5MW of electricity from solar power will contribute to lowering the need to use energy generated from sources that are releasing GHG. No enhancement measures are proposed since the power will be internal use by Bamburi Cement.

E7.2 Negative Impacts and Mitigation Measures

a) Fugitive Dust and Exhaust Emissions

Impacts - Fugitive dust and exhaust emissions will arise during construction activities at the site and vehicle movements inside the site and outside. Stockpile materials from excavations will also generate fugitive dust.

Mitigations – Removal of vegetation form the project footprint areas only. Control of vehicles speeds and Sprinkling water to suppress dust. Vehicles should be well maintained and unnecessary raving of engines and idling should be minimized to reduce exhausted emissions. Workers to be provided nose masks to protect them from inhalation of fugitive dust and exhaust emissions.

b) Noise Emissions

Impacts – Machinery and vehicles being used during construction will generate noise.

Mitigations – Ensuring vehicles and machines are well maintained. Minimizing vehicle movements and instructing drivers to minimis raving of vehicles and other machinery. Workers to be provided ear muffs to protect them from excess noise.

c) Biodiversity

Impacts – Site vegetation clearing will have impact on flora through loss of habitat and segregation. There is high potential for invasive species to invade cleared areas.

Mitigations – On clear vegetation from the project footprint areas. Carry out clearing of vegetation systematically and with caution to allow for fauna to migrate to neighbouring areas. Uproot any invasive species that emerge in a timely manner. Ensure workers do not kill any fauna encountered at the site. Promote the planting of trees in areas not directly affected and nurture them to grow.

d) Physical Cultural Resources

Impacts – The field survey established that the proposed site is a currently used as a dumping site. The stratigraphy is disturbed hence very unlikely to contain any archaeological cultural heritage resources. No archaeological features were seen on the surface. The absence of archaeological or cultural heritage materials on the surface may not preclude the possibility of their existence in secondary context especially those that may have been introduced from the damping materials in the ground.

Mitigations – It is thus recommended that the developer immediately notifies the National Museums of Kenya (NMK) if any archaeological materials are detected/uncovered in the course of project preparing the site for operation. A Chance Finds Procedure (CFP) is provided for this purpose.

e) Soil Erosion and Contamination

Impacts – During site preparation, soil will be excavated and made loose**.** This will result in soil erosion and siltation of downstream surface water sources like Athi River that passes approx..1km away from the site. Oils, fuels and chemicals used at the site may spill on to the soil and cause contamination.

Mitigations – Put in place soil control measures including compacting excavated soil, sprinkling of water and ensuring speedy removal of excavated soil for appropriate reuse or disposal. Machines and vehicles to be well maintained to avoid oi leaks to the ground. Oils, fuels and hydraulic fluids are to be stored on paved areas with containment.

f) Solid and Liquid Waste

Impacts – During construction, the domestic waste from the contractor's camp and construction waste from construction activities will be generated. There will also be sanitary waste generated at the site.

Mitigations – Contractor shall provide appropriate waste bins within the site and encourage waste segregation. A NEMA registered firm shall be engaged to collect waste for appropriate disposal. Sanitary waste shall also be collected by a NEMA registered firm. Hazardous waste like used oil and hydraulic fluid is generated, the Contractor shall manage the handling of such waste through the use of a Chain of Custody Form for accountability. ANEMA registered hazardous waste handling firm shall be engaged to dispose of such waste.

g) Occupational Health and Safety

Impacts – Injuries or accidents may occur during construction arising from using machines and tools. Those working at heights may be exposed to falls.

Mitigations – Contractor to prepare and implement and Occupational Safety and Health Management Plan (OSHMP) and provide workers with appropriate PPE to protect them injuries. Those working at heights shall be provided with harnesses. Contractor to ensure PPEs are well used by workers.

h) HIV and Communicable Diseases STIs

Impacts – The project area is susceptible to the spread of HIV/AIDS and other communicable diseases

Mitigations – Contractor to provide HIV/STIs Management Plan. And sensitize workers and the community on prevention mechanisms. Provision of protection items like condoms to be availed to workers.

i) Community Health and Safety

Impacts -The presence of machinery and vehicles moving in and out of the project site may pose safety risks to community members or those using the access road to the site.

Mitigation – Evaluation of risks associated with vehicle and machine movements to be done and measures put in place including identification of appropriate routes and instruction of drivers to control speeds.

j) Impact of Increased Traffic

Impacts – The road accessing the site experiences traffic holdups due to the trucks visiting the area to deliver materials and collect finished goods from the factories in the area. The Contractors vehicles will also increase this traffic.

Mitigations – Contractor to prepare a Traffic Management Plan for construction activities. Traffic Marshals to be provided to control traffic near the entrance to the site to avoid accident occurring.

k) Water Resources

Impacts – Construction activities will have modest demand for water. However, during operation, the demand for water will shoot-up due to the need to clean the modules. A total of 7,938 modules shall require a total of 15,876 litres of water for one event cleaning. This means that 190,512 litres of water will be required over a period of 1 year if cleaning is don monthly.

Mitigation – Project to drill a dedicated borehole for the project operations at the facility**.**

E8 Grievance Management/Redress Mechanism

A Grievance Redress Mechanism GRM has been formulated to receive and facilitate resolution of complainants (project affected people, local community and workers) concerns and grievances regarding the project's performance during the construction, operation and decommissioning phases of the project. The mechanism will be able to address the concerns and complaints in a timely fashion by using an easy to understand, transparent and effective grievance redress process that is readily accessible to all segments of the project area population including workers and community members.

E9 COMMUNITY DEVELOPMENT ACTION/FRAMEWORK

The Consultant engaged with the local community and from these consultations, certain socio-economic areas were found to be inadequate, a list of which has been provided under Chapter 9 of this report.

E10 CONCLUSION AND RECOMMENDATIONS

E10.1 Conclusion

The proposed Solar PV Power Plant is not expected to cause any significant adverse effects on the surrounding environment. On the other hand, it will help Bamburi Cement PLC save power on costs and contribute to the reduction of GHG emissions.

E10.2 Recommendation

Therefore, the Solar PV Power Plant can be implemented at the proposed site. All the mitigation measures provided in the ESMP and the Monitoring Plan need to be implemented as indicated to safeguard the biodiversity and physical environment of the project area. Health and Safety of the workers and community members have also been identified as key areas that require dedicated observance. Environmental, Social and Health issues of the project need to be monitored, data analysed and used to improve the safeguards performance of the project.

1 INTRODUCTION

1.1 Project Background

Momnai Energy Ltd intends to develop a Solar PV Power Plant (5MWac) at Athi River, Machakos County. Bamburi will provide the land on sub-lease basis for the project for 25 years at its production site in Athi River. The Plant will be located at its Nairobi Grinding Plant in Athi River, just off Mombasa Road. The power generated from the plant will be evacuated to an existing Substation facility located approx. 2 Km south of the Solar Plant. The Solar PV Power Plant and Transmission Line will be confined within Bamburi Cement PLC land.

1.2 Project Proponent

The Solar PV Power Plant Facility is being developed by:

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Bamburi Cement PLC has entered into a Power Purchase Agreement (PPA) with the Momnai Energy Ltd.

1.3 Project Location and Site

1.3.1 Project Location

The proposed Solar PV Power Plant will be located at its Nairobi Grinding Plant in Athi River, along the Old Nairobi-Mombasa Road. The Connection will be made to the existing Sub-station located within the Grinding Plant. The decimal coordinates of the Athi River Plant are -1.434850, 36.959833. The land lies at an altitude of approx. 1,500m above mean sea level.

Refer to **Map 1** for the location of the site where the proposed Solar PV Power Plant in Athi River, Machakos County, will be located.

1.3.2 The Site

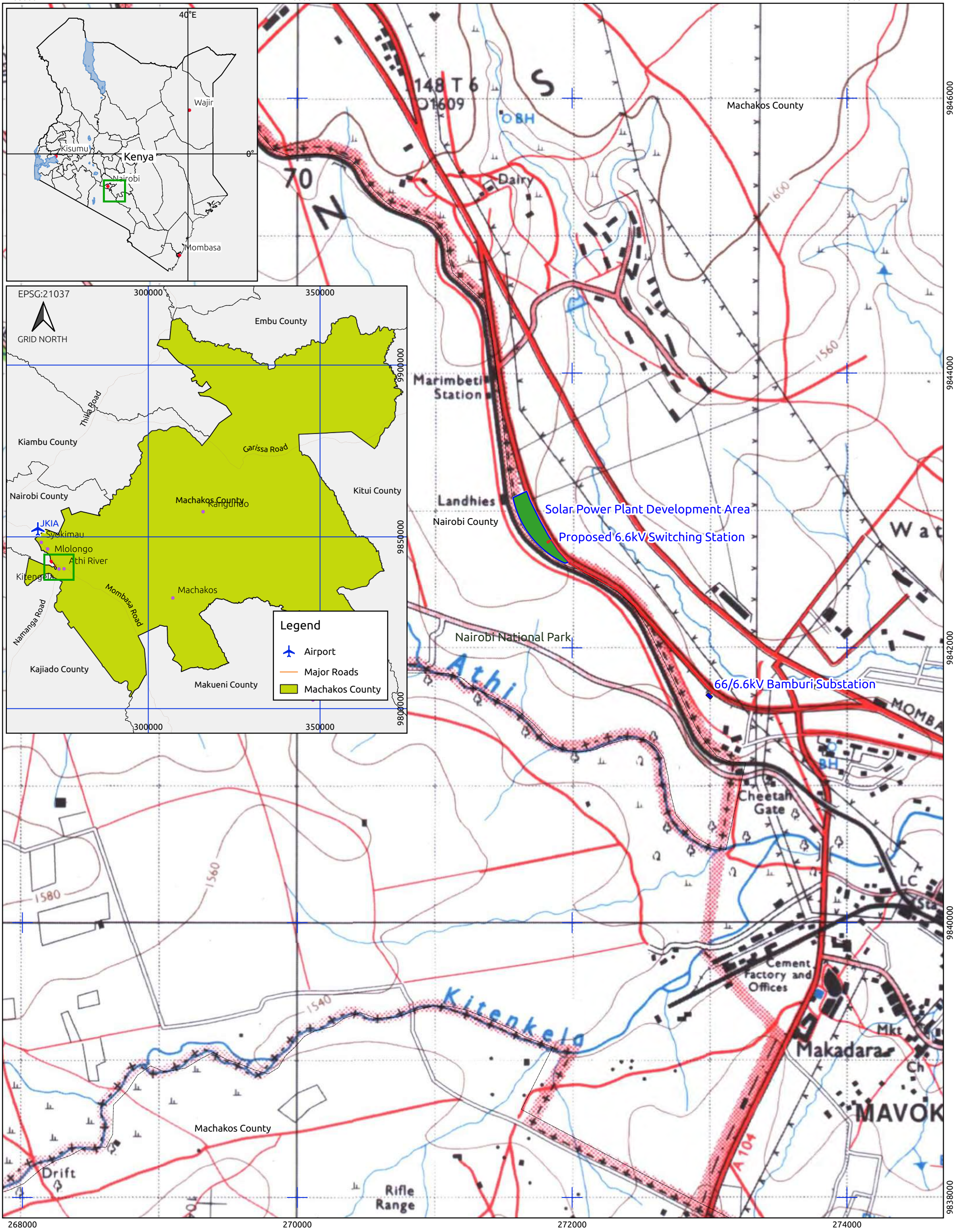
Beyond the old and the Standard Gauge Railway lines that border the western and southern boundary of the site lies the Nairobi National Park (Details of the impacts to be provided in the Baseline (Chapter 4) and Impacts (Chapter 7). Refer to **Maps 1 & 2**.

Bamburi Ready Mix Concrete Factory borders the site on the northern side. Poly Tanks and Containers Kenya Ltd lies on the eastern side of the site across the road.

The proposed site is currently unoccupied however:

- The southern area of the Solar Farm has been used by Nairobi Grinding Plant to store raw materials for the grinding plant;
- The middle section of the site has been used as a dumping ground for wastes by members of the public since the site is not fenced hence easily accessible.

- Some of the dumped materials include Construction wastes, clinical/medical wastes, asbestos roofing tiles, construction waste and a makeshift residential structure.



Environmental, Social and Health Impact Assessment for Proposed Momnai Solar Farm Power Project at Athi River

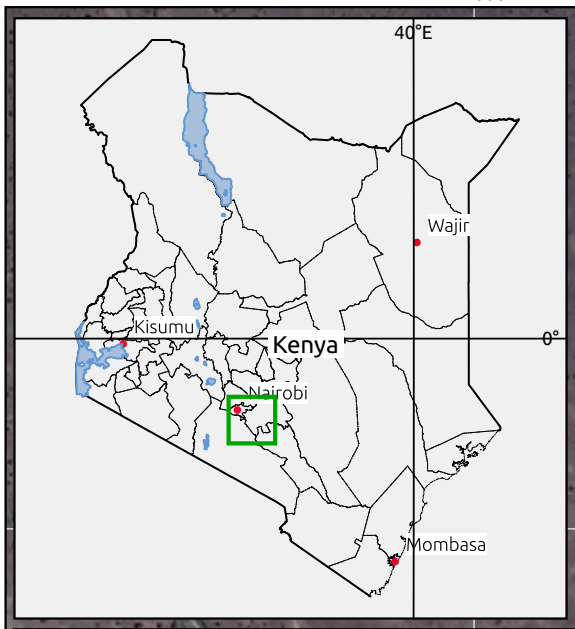
Map Sheet 1 : Proposed Athi River Power Plant

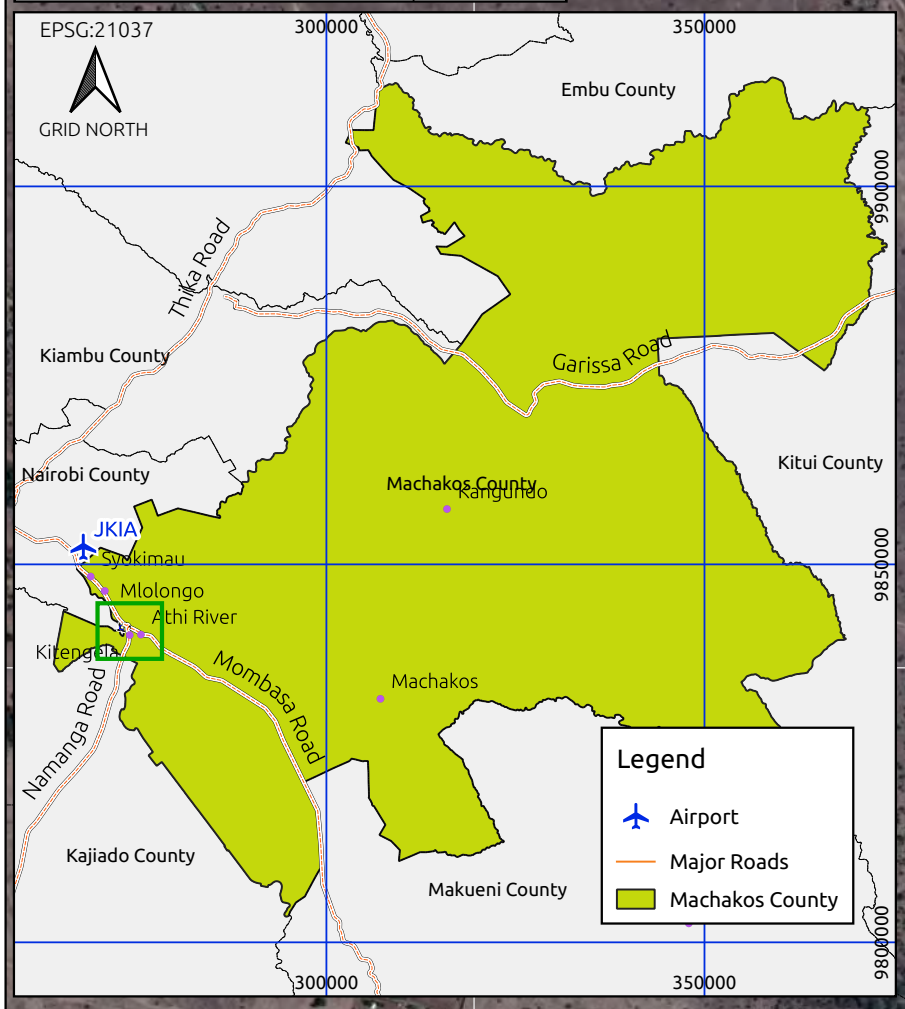
500 0 500 1000 1500 m

EPSG:21037
Grid North

LEGEND
- Bamburi Substation
- Power Plant Development Area

271000
272000
273000
9843000
9842000
9841000





Machakos County

Solar Power
Plant Development Area

Nairobi County

Nairobi National Park

66kV Sub-station

Machakos County

Environmental, Social and Health Impact Assessment for Proposed Momnai Solar Farm Power Project at Athi River

Map Sheet 2 : Proposed Athi River Power Plant

250 0 250 500 750 m

EPSG:21037
Grid North

LEGEND
- Power Plant Development Area
- Sub-Station
- Cadastral Boundary

1.4 Power Generation

The electricity sub-sector in Kenya has witnessed various reforms that have led to efficiency and revamped competition. Electricity generation is completely unbundled with increased private sector participation while electricity transmission is undertaken by both Kenya Power and the Kenya Electricity Transmission Company (KETRACO). The distribution segment is mainly carried out by Kenya Power. However, a number of mini-grids have been licensed to supply to customers in marginalized areas and selected gated communities (EPRA, 2021).

1.4.1 Installed Electricity Capacity in Kenya

The total installed capacity with the inclusion of off-grid power was recorded at 2984MW as at May 2021. **Table 1** below presents an analysis of the installed electricity capacity by technology.

Table 1: Power Generation Capacity (MW)

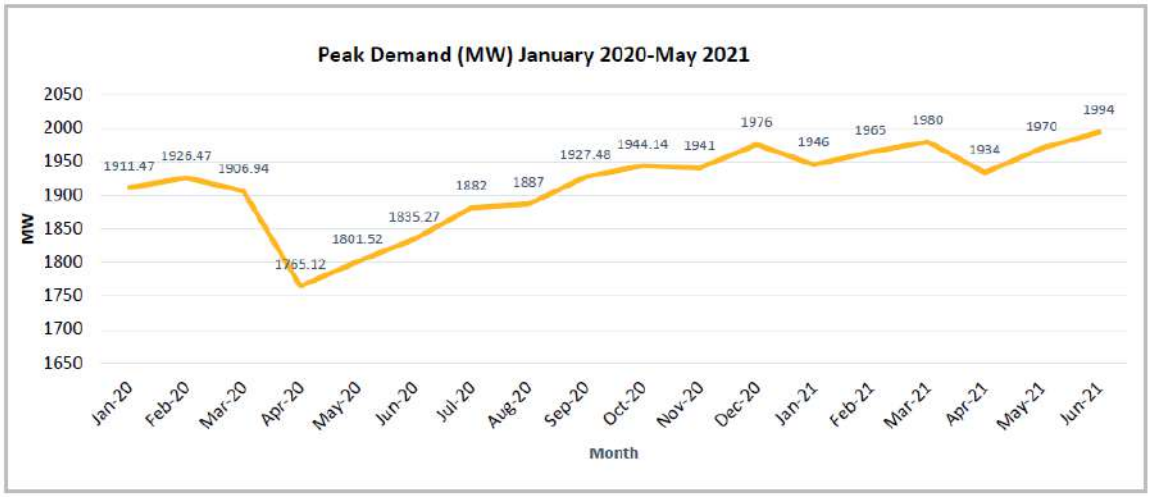
Capacity in June 2021	Installed MW	Effective MW
Hydro	838.10	809.10
Geothermal	863.13	805.10
Thermal (MSD)	660.32	640.40
Thermal (GT)	60.00	56.00
Wind	435.50	375.50
Biomass	2.00	2.00
Solar	90.25	90.30
Interconnected System	**2,949.30**	**2,788.40**
Off grid thermal	31.50	21.30
Off grid wind	0.55	-
Off grid solar	2.26	1.90
Imports	-	-
Total Capacity MW	**2,984.00**	**2,802.00**

Source: EPRA (2021)

1.4.2 Analysis of Electricity Peak Demand

As per **Figure 1** below, the Peak demand was recorded at 1994MW on 8th June 2021 against a total installed capacity of 2984 MW.

Figure 1: Trend in Peak Demand January -June 2021



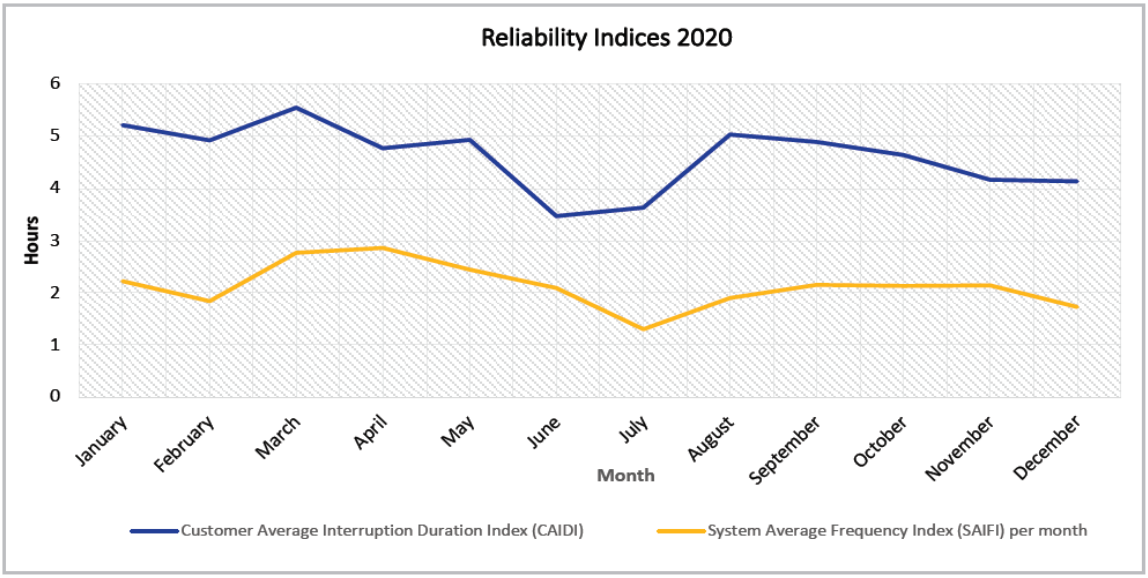
Source: EPRA (2021)

1.4.3 Reliability Indices

a) EPRA

EPRA uses the System Average Interruption Frequency Index (SAIFI) and Customer Average Interruption Duration Index (CAIDI) to measure the reliability of power supply in Kenya. Figure 4 shows the SAIFI and CAIDI for the year 2020. The high loss of power is a clear indication that much more needs to be done to improve on reliability of power supply to customers (EPRA, 2021). **Figure 2** below shows the trend in Reliability indices January-December2020.

Figure 2: Trend in Reliability Indices January-December 2020



Source: EPRA (2021)

b) KPLC

In addition to SAIFI, explained above, Kenya power also uses, SAIDI (System Average Interruption Duration Index) as a measure of the reliability of their supply. This is measured in hours over the course of a year in accordance to IEEE Standard 1366-200. Internally Kenya Power has grouped its customers into 8 regions, one of which is Nairobi. In turn Nairobi has 6 sub-regions. For 3 of these the reliability Indices for the period January to December 2020 were as follows.

Table 2: Reliability Indices for the Period January to December 2020

KPLC Sub Region	Sum of Numerator SAIFI	Sum of Numerator SAIDI	No. of Customers	SAIDI (Hrs)	SAIFI	CAIDI (Hrs)
Nairobi North County	4,464,806	11,501,220	879,437	13.1	5.1	2.6
Nairobi South County	3,569,047	10,548,724	985,463	10.7	3.6	3
Nairobi West County	3,919,018	8,760,966	817,949	10.7	4.8	2.2
Grand Total	**11,952,872**	**30,810,910**	**2,682,849**	**11.5**	**4.5**	**2.6**

Source: Kenya Power (2022)[1]

[1] https://kplc.co.ke/content/item/794/saidi---saifi#:~:text=System%20Average%20Interruption%20Frequency%20Index%20(SAIFI)&text=SAIFI%20is%20measured%20in%20units,to%20IEEE%20Standard%201366%2D2003.

The proposed Solar PV Power Plant will be interconnected at the Athi River Bamburi Cement Plant which is supplied at 66kV through a 66kV overhead line originating from the 220/66kV Kenya Power's Kitengela substation. This substation is within Kenya Power's Nairobi South Sub-region. The electricity supply in this sub-region is fairly reliable with the average duration of power outage (SAIDI), as mentioned by Kenya Power below 11 hours per year (in the year 2020). This is important for both factory operations and on grid solar generation. For solar PV generations it means the interruptions to generation are minimised.

c) **Industrial Customers in Athi River Area**

Athi River area where the proposed Solar PV Power Plant is located, is largely an industrial area with many factories including Bamburi Ready Mix Cement Factory, Poly Tanks and Containers Kenya Ltd, Ndovu Cement, SPA Industry, Exon Industries (Pty) Ltd, Euro Star Industrial Limited, Mold Plast Kenya Limited and Shalom Hospital. Electricity Supply for the operations of these factories is provided by Kenya Power through the National Grid. According to most of these users, the supply is inadequate as it is occasioned by frequent interruptions and rationing. Due to the frequent power interruptions, most industries have installed backup generators which are pollutants and are costly to run. The generators in most instances, are not able to run the factories at full capacity yet the production costs escalate.

1.4.4 Electricity Cost (KWhr)

Electricity in Kenya is sold under a tariff heading which has a base tariff plus several adjustments and levies that add up to the total cost. The tariff heading for the Athi River Bamburi Cement plant is CI4 (Commercial & Industrial – 66KV). During 2018 – 2021, the base tariff under CI2 was Kshs 10.3/ KWhr. In Jan 2022, the base tariff was reduced to Kshs 7.80 / KWhr. It is not clear whether this reduction will be sustained beyond 2022. When the base tariff was Kshs 10.3/ KWhr, the aggregate cost of power was about Kshs 19/ KWhr (all costs considered). The reduction of base tariff from Kshs 10.3 to Kshs 7.80/ KWhr brings the aggregate cost to about Kshs 15/ KWhr.

1.5 Project Justification

Bamburi Cement is large consumer of electrical energy to power its operations. The Electricity from the grid is a combination of thermal/hydro and geothermal. The power from the grid is expensive with frequent power interruptions. In order to ensure constant supply of affordable clean energy, Bamburi has decided to provide land on sub-lease basis for the project for 25 years for a Power Purchase Agreement (PPA). The proposed Solar PV Power Plant will generate 5MWac which will meet substantial part of Bamburi's power demand. This will offload the power currently being used by Bamburi and make it available for the ever-increasing demand for power from the National grid. Bamburi Cement will also contribute to its sustainability strategy of reducing Green House Gas (GHG) emission.

1.6 Justification of the ESHIA Study

The Objective of the study is to carry out detailed ESHIA Study for the proposed Solar PV Power Plant at Bamburi Site in Athi River and prepare ESHIA Study Report in compliance with the following guidelines and standards.

a) National Environmental Management Authority (NEMA)

The proposed Solar Plant project is listed under the second schedule of section 58(4) of the Environmental Management and Coordination Act, 1999 (Rev, 2015) and Legal Notice No. 101 of June 2003 (Environmental Impact Assessment and Audit Regulations (Rev. 2019) as a project to be subjected to an Environmental Impact Assessment (EIA). It is categorized as medium risk project.

b) International Standards and Guidelines

IFC Standards require an assessment and management of environmental and social risks and impacts of development projects, which includes stakeholder engagement, analysis and planning, disclosure and dissemination of information and grievance redress mechanism. The proposed project has minimal environmental and social impacts that will arise during construction and operation therefore falls under Category B of IFC PS1.

According to EIB Environmental and Social Standards, the project is listed under Annex II - Industry Energy that requires screening and development of necessary mitigation measures and therefore falls under Category B.

Other international environmental and social assessment standards adhered to in this report include the World Bank Group EHS Guidelines and International Labour Organization (ILO) Conventions.

The purpose of this ESHIA Study is to provide an environmental, health and social assessment of the Project against the requirements of the National Environmental Management Authority (NEMA), IFC Performance Standards, EIB Environmental and Social Standards, associated World Bank (WB) Group's Environmental, Health and Safety (EHS) Guidelines, and International Labour Organization (ILO) Conventions. Momnai Energy are committed to implementing the project by adhering to the above standards.

This Environmental, Social and Health Impact Assessment Study has identified both positive and negative impacts of the proposed project. The mitigation measures to address the potential negative impacts has been elaborated in the Environmental, Social and Health Management Plan (ESMP) under ***Chapters 7 & 8***

1.6.1 Specific objectives are to:

- Improve the environmental and social design of the Project;
- Highlight during the preliminary stages of the project any red flags that may render the project environmentally or socially unfeasible or unsustainable and may result in excess expenditure to implement adequate and appropriate mitigation measures, or jeopardize the Project in any way;
- Prepare a Stakeholder Engagement Plan which can be used during the ESHIA process as well as during the construction and operation phases of the Project;
- Identify all potentially adverse environmental and social impacts of the Project and recommend measures for mitigation;
- Develop a comprehensive Environmental, Social and Health Monitoring and Management Plan (ESHMMP), including mitigation costs;
- Prepare an ESHIA Study Report that meets national regulations and guidelines;
- Prepare a bankable ESHIA Study Report that meets IFC Performance Standards and European Investment Bank's Environmental and Social Standards, The World Bank Group EHS Guidelines and International Labour Organization (ILO) Conventions.

1.6.2 Target Group for the ESHIA Study

This ESHIA Report has been prepared for use by different stakeholders that will be involved in the construction, operation and monitoring of the proposed Transmission Line. The report contains useful information on policies, procedures, implementation modalities, analysis of potential environmental, health and social impacts and suggested mitigation measures at various stages of the project activities that need to be adhered to. The information will be useful during planning, implementation, management, maintenance, monitoring and decommissioning of the facility. In this regard, the report will be useful to the following stakeholders:

- Investors, Co-Investors and All Limited Partners;
- Contractor(s) that will be engaged for the construction, operation and decommissioning works of the project;
- Affected and Interested persons including project area communities;
- Relevant government agencies (National and County Governments);
- Planners and Engineers that are involved in the preparation of project designs and plans;
- Persons that will be involved in the management and operation of the facility.

1.7 ESHIA Study Methodology

The ESHIA methodology follows a systematic process that predicts and evaluates the impacts the project could have on the physical, biological, social/ socio-economic and cultural environment, and identifies measures that the Project will take to avoid, reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable.

The study methodology comprised the following activities:

- Preliminary Meetings;
- Desktop Review;
- Environmental Screening;
- Environmental Scoping;
- Stakeholder Engagement
  - ✓ Initial Stakeholder / Sensitization Meetings;
  - ✓ Public Consultation Meeting;
  - ✓ Public Disclosure Meeting.
- Environmental Baseline Data collection;
  - ✓ Site Evaluation and Collection of Biophysical Data
  - ✓ Soil Analysis
  - ✓ Air Quality Assessment
  - ✓ Noise Measurements
- Ecological Assessment;
- Archaeological Assessment;
- Baseline Socio-Economic Studies;
- Data Evaluation, Analysis and Reporting

1.7.1 Preliminary Meetings

Preliminary meetings were held with the Proponent (Momnai Energy) and Bamburi Cement PLC to obtain relevant project information on the proposed 5MW Solar PV Power Plant in Athi River. Planning for the execution of field activities was also undertaken. Details of the meetings and outcome are provided in **Chapter 6**.

1.7.2 Desktop Review

The desktop review (published documents) was carried out to identify any environmental, social, health and ecological sensitivities around the project site. This included review of the land use, land cover and topography (Toppo sheet, Satellite imagery), vegetation type and floral and faunal species assemblage in the study area. Information provided by developer (Project site location boundary map, vital installations specifications) was also considered during desktop review process.

Further review was done on:

- Existing legislature, regulations and policies relevant to the proposed project
- Proposed project engineering designs and construction inputs.
- The land ownership documents.

1.7.3 Environmental Screening

The criteria used in screening was based on NEMA Schedule II of Legal Notice No. 101 of 2003, IFC PS1 and EIB S1 and included the following;

- Ecological considerations (Biological diversity, sustainability, ecosystem maintenance)
- Social considerations (economic impacts, social cohesion and disruption, effect on human health, communication, effects on culture and objects of cultural value)
- Landscape impacts (views opened up or closed, visual impacts, compatibility with surrounding area);
- Land uses (effect of proposal on current land uses and land use potentials in the project area, possibility of multiple use, effects of proposal on surrounding land uses and land use potentials)
- Water (impact of proposed project on water resources and drainage patterns or systems)

The outcome of the screening exercise is provided in **Table 3** below.

Table 3: Results of the Screening Criteria

No	Criteria	Results
1	Ecological Impact	• Raw materials such as aggregates and sand will have ecological impacts at points of origin • Vegetation clearance will occur prior to excavation, construction and installation works • Excavations will be undertaken and will impact on the soil profile of the area • Potential displacement of fauna from their habitat • Since the site is not fenced, there is dumping of construction, medical and industrial wastes. Remnants of asbestos roofing materials are also present and will require special procedures of handling and disposal. A hazardous Waste Management Plan will need to be prepared by the Contractor and used to execute the waste removal before site clearing is done.
2	Social Considerations	• Some of the commercial operations within the project area use this unfenced land belonging to Bamburi Cement to dump their wastes • One temporary residential structure made of polythene material exists at the site • Project will ensure steady supply of solar power • Investment will accrue income to proponent • Project will create employment • There will be revenue to the government in the form of levies and taxes • Potential impacts from Labour Influx • Potential occurrence of GBV, SEA and VAC • There are no cultural or heritage issues at the site

No	Criteria	Results
3	Landscape Impacts	• No significant impacts on landscape taking into consideration that the solar panels will not rise high above 2 metres, however some form of ground levelling will be done
4	Land Uses	• The project area is generally characterised by commercial, industrial uses • The dumping of waste on the project site was being done in the middle section • A section of the southern part of the project site was being used by Bamburi to store raw material for its Nairobi Grinding Plant. At the time of the scoping, the materials were being removed.
5	Water	• Bamburi Plant in Athi River uses borehole water for its operations due to rationing and frequent water shortage • The Solar Plant will mainly rely on borehole water supply (Refer to section 3.2.9 for requirements for sinking a borehole) • Abstraction may have an impact on water resources in the area

1.7.4 Environmental Scoping

The scoping has been carried out to identify the potential Area of Influence (AoI) for this project, identify the potential interactions between the project activities and resources/receptors in the project AoI and the impacts that could arise from these interactions, and to prioritize these impacts in terms of their likely significance. The scoping exercise helped narrow down onto the most critical issues requiring attention during the assessment. The Environmental issues were categorized into physical, natural/ecological, social, economic and cultural aspects.

During the Scoping study, the following activities were executed:

- The baseline physical assessment of the site and the immediate surrounding areas;
- Initial Key Stakeholder consultations to:
  - ✓ Inform them about the project and the planned activities regarding the ESHIA Study;
  - ✓ Seek their views regarding the project;
  - ✓ Obtain relevant project information.

1.7.5 Stakeholder Engagement

The stakeholder engagement process involved the following steps:

1.7.5.1 Initial Stakeholder / Sensitization Meetings

Sensitization Meetings were carried out with Key Informants including local administration to inform them about the proposed project and the planned ESHIA Study activities. This was carried out between November 4 2021 and January 21, 2022. The Key Informants contacted included County Government, Government Agencies, Service Providers and Local Administration among others. Some of the Key Informants filled in ESHIA questionnaires on the proposed project. Virtual meetings were also carried out with some Key Informants.

1.7.5.2 Public Consultation Meeting

The Public Consultation Meeting was arranged and carried out on Wednesday February 9, 2022. Project area community were invited to the meeting using the following media:

- ✓ Announcements through chiefs' office in the project area for a period of 1 week prior to the meeting;
- ✓ Announcement posters distributed through the chief's office
- ✓ Radio announcement for period of 1 week prior to the date of the meeting

The details and outcome of the meetings are provided under **Chapter 6** of this report.

1.7.5.3 Public Disclosure Meeting

Project impacts disclosure meeting was carried out on Friday 22, April 2022. The meeting was convened to disclose the findings of the study and the project mitigation measures that will be carried out to mitigate the identified impacts. It also discussed the next steps in the project process. The key outcomes of the meeting were:

- The identified impacts can be managed through the mitigations provided in the ESMP;
- The community and the other stakeholders supported the implementation of the project.

The detailed outcome of the disclosure meeting is presented under **Appendix 5**.

1.7.6 Environmental Baseline Data Collection

(a) Site Evaluation and Collection of Biophysical Information

Physical project site inspections and observations constituted the main baseline survey activities. The Solar PV Power Plant is going to be located inside unfenced Bamburi land in an area that is currently used for stockpiling of raw material by Bamburi Cement and also exhibits high level of illegal dumping of construction, medical and industrial wastes.

(b) Soil

Soil samples were taken and analyzed for Total Petroleum Hydrocarbons (TPH) and Heavy Metals [Lead (Pb), Nickel (Ni), Cadmium (Cd), Mercury (Hg), Chromium (Cr) and Lithium (Li)]. The result of the analysis is provided in **Appendix 6.**

(c) Air Quality Assessment

The proposed site was evaluated for potential sources of air emissions including fugitive dust and exhaust emissions from vehicles and machinery. Baseline air quality measurements were carried out by NEMA Registered Laboratory Baseline measurements made included Hydrocarbons, Particulate Matter (PM_{10},) Sulphur Dioxide and Nitrogen Dioxide. Refer to **Appendix 8** for Air Quality measurements.

(d) Noise Measurements

Baseline Noise measurements were also made within the project area to determine the baseline noise conditions of the project area. Refer to **Appendix 7** for measurement results.

1.7.7 Ecological Survey

Specialised ecological survey was carried out at the proposed site to determine any existence flora and fauna species that may be affected by the proposed project. This evaluation included determination whether there are any endangered/threatened species.

(a) Vegetation

Botanist in the study team carried out specialized study to determine the type of plants that exist within the site and how they would be impacted by the proposed project and appropriate mitigation measures.

A plot-less method involving random walks as developed by Hall and Swaine (1981) was used to establish plant species diversity and capture habitat types. All vascular plant species were recorded and specimens collected using standard methods (Foreman & Bridson, 1992). Most species were identified on site and the difficult ones collected for confirmation at the East African Herbarium.

Identification of indigenous vascular plants followed Agnew (2013), Beentje (1994) and various publications of the Flora of Tropical East Africa.

(b) Avifauna

An Ornithologist carried out an assessment on the various birds that exist in the project area and determined the potential project impacts and mitigation measures. Threatened/endangered species were also identified.

Point transect: Birds were surveyed within the entire block using point counts based on distance sampling protocol to estimate the abundance of birds and species richness (Thomas et al 2010). Along each transect, point counts were conducted at intervals of 200 m. At every point observers counted all the birds seen or heard within a 100m radius for 10 minutes (Bibby et al 2000). **Total Counts:** Birds occurring in flocks especially in flight were counted directly to establish the total number (Bibby et al 2000, Pomeroy 1992).
Nocturnal Surveys: Night searches were conducted in the entire area to observe night foraging birds and detect vocalizations of nocturnal species such as nightjars and thick-knees.
Vantage Points (VPs): In order to understand which birds use the aerial space within the proposed project area, we made observation from vantage point during the day. The following parameters were taken: Species, number of birds, time observed, flight direction, flight height etc .

(c) Mammals

Three main methods were used to sample mammals in the study area as described below.

***Bats sampling*:** Bat were captured with three mist-nets (18m (two) and one 12m (total 48m (Kunz et al. 1996). Mist-nets were opened at 19.00pm and were monitored for two hours until 21.00pm. All captured individuals of bats were identified and released back to the wild at the point of capture. Insectivorous bat activity was monitored with (Pettersson Elektronik ABTM, Uppsala, Sweden (http://www.batsound.com/) in heterodyne mode (Estrada et al. 2004; Musila et al., 2018). The detector was tuned first to 30 kHz, and frequencies varied after each one minute to 47, 56, 73, 90, 107, and 124 kHz. Bat activity was quantified as passes, which is a single sequence of two or more recorded echolocation calls as defined by Thomas (1988). The number of passes were used as a sampling unit for general bat activity (Frick 2013). Bat passes were counted along 10-minute transects at the start of each hour from 19.00-21.00hr. Because the Pettersson D200X has bandwidth of 8 kHz (Musila et al. 2018), it was possible to detect the presence of bat species whose echolocation is within the range of 22-128kHz, if they were available at each sampling site surveyed by varying the frequency detector setting from 30-124 kHz. Bat inventory was undertaken at section A and B of the study area.

Rodent sampling: Rodents and shrews were sampled with Sherman traps (10) and metal snap traps (20 (Musila et al. 2019). The snap traps were set at intervals of 10-10m from each other, and were baited with one raw peanut seed. Sherman traps were baited with oat flakes. All the traps were placed at microhabitats where small mammals (rodents, shrews) were predicted to occur including well defined animal trails, their burrows or places where some droppings were visible. Traps were set in the morning in each transect, and maintained in one transect for one night. Traps were checked once every morning between (before 8am) removed and moved to the next trapping station in a different block. All captured individuals of rodents were identified and released back to the wild at the point of capture and some prepared into museum specimens by skinning and stuffing with cotton wool and deposited with Mammalogy Section Lab, National Museums of Kenya. Rodent inventory was undertaken at section A and B of the study area.

***Transect surveys*:** Direct and indirect methods were used to survey mammals in sections (ABC) of the land by using a 200m transect located in the entire block of land from east to west. Searches were done by walking along the transect in the morning and evening (Gurnell et al. 2004) at a distance of 30m from the center of walking path (width of transect 60M). Direct methods included identifying individuals of mammal species seen during transect searches. Indirect methods included using signs of mammals to record the presence of mammals, such as footprints/tracks, scats and burrows (Kingdon 2015). The searches included walking along the transect, listening for animal calls, searching for animal movement in the bushes and trees; as well as scats and footprints of animals on the ground. Any animal sighted or flushed from the bushes or trees; or footprints or scats, and burrows found were identified to species.

(d) Entomofauna

The Entomologist carried out specialist studies of the insects that exist in the project area and how the project may impact on their existence. Standardised and opportunistic invertebrate collection methods were applied in selected habitat types. There were three selected points in each habitat. The specimens were labelled and preserved in 70% ethanol.

Various methods including use of pitfalls, colored pan traps, baited butterfly traps (BBT) and general search involving sweep netting and habitat search were applied in this study. Pitfalls majorly targeted the ground dwelling arthropods. These included the snails, spiders, earwigs, ants, millipedes, centipedes among others. These specimens are those without flying ability. The method involved burying the cup in a dug up pit ensuring that it is the same level as the ground so that while crawling they just fall in the trap (Upton & Chapman, 2010; Nève, 2012). The cup was then filled halfway with a mix of water and soap and left overnight to collect specimens. Three traps were set in each point and a total of nine traps were set in the sampling site. Pan traps utilised the use of colored plastic traps (blue, white, yellow) which was applied here to collected flower visiting specimens (bees, flies, wasps) and also those that stay in trees like web spinning spiders. In each point, nine pan traps were set. A total of 27 traps were set in the site. A mixture of water and soap was added to the traps which were then left overnight and emptied the following day in the morning. Both pitfalls and pan traps were left collecting specimens in the field for two days.

The BBT involved a butterfly trap containing bait. A mixture of ripe bananas and pineapples was prepared and left until fermentation (at least 48 hours). The trap was hoisted in a tree and bait was added to attract flying insects especially butterflies. Three traps were set in each point each morning and emptied evening to avoid vandalism and also destruction of the traps by animals (Freitas et al. 2014). Three traps were set in each point and nine in total in the site. After all the passive traps were set, the remainder of the time was used to actively search for invertebrates within the transect. The methods applied were sweep netting and general search hand picking specimens using a pair of forceps. The target species included those that hide under rocks, in foliage and also flying insects that may not be captured in the set traps.

(e) Herpetofauna

The Herpetologist carried out field sampling of reptiles and amphibians from November 30, 2021 to December 3, 2021 at the proposed project site in Athi River. A combination of three main techniques were applied: i) Visual encounter survey (VES) was used. Due to the flexibility and simplicity of the method, VES is frequently used for rapid assessments and the evaluation of larger areas to generate species inventories (Rödel & Ernst, 2004; Heyer et al., 2014; McDiarmid et al., 2012). The site was actively searched by the expert assisted by a local guide for potential breeding areas of amphibians (e.g. marsh, small water pools, water channels) and suitable microhabitats for both amphibians and reptiles (e.g. stones, crevices, leaf litter/debris, rotten log). It was necessary to examine or uncover these places deliberately to search for the eggs and tadpoles of amphibians in aquatic habitats or to reveal the presence of the amphibians and reptiles hiding under these covers.

This was applied along transect lines across the site besides general surveys of the whole site with focus on suitable microhabitats. ii) Additionally, pitfall traps using sunken buckets were also used to trap small reptiles and amphibians. At least three (3) trap arrays consisting of five (5) traps each were deployed within the area. Iii). To supplement the two methods above, nocturnal sampling mainly targeting amphibian habitats was implemented between 6.00 pm and 9.00 pm in a pre-identified artificial wetland adjacent to the Ready-Mix concrete plant. All species observed were identified following Spawls et al. (2018), Channing and Rodell (2019) and Frost (2021). Species conservation status were based on IUCN Red list Version 2021-2 (IUCN, 2021). Project impacts were deduced and appropriate mitigation measures proposed.

1.7.8 Physical Cultural Resources

Archaeological and Cultural Heritage impact assessment has been undertaken to identify and ensure the protection of archaeological and cultural heritage assets associated with the project footprint area/sites to ensure that effective management and mitigation controls are in place. The assessment included a desktop review of any available documents and records associated with archaeological and cultural heritage resources within the project sites as well as field survey of project site. The major set of data was mined from the archaeological and cultural heritage records filed with the National Museums of Kenya through its Standard African Site Enumerations System (SASES).

1.7.9 Baseline Socio Economic Studies

(a) Recruitment of Enumerators

Enumerators were identified within the project area and recruited through the local administration to assist the Consultant in the administration of socioeconomic questionnaires. Before executing the task, they were taken through an induction course to train them how to communicate to the respondents and administer the socioeconomic questionnaire.

(b) Conducting the Survey

During the Public Consultation Meeting (PCM), the project area community were informed that as part of the Consultations during the study, a few members of the Consultant team and enumerators from their community will visit them at their residences and businesses to administer questionnaires. The survey was therefore carried out after convening the PCM.

1.7.10 Data Evaluation, Analysis and Reporting

a) Environmental Impact Identification and Analysis

Environmental assessment was carried out to identify potential impacts of the project on the environment, biodiversity and the community. The assessment was carried out in three main steps, as follows:

- Prediction of potential impacts
- Execution of specialized ecological studies on biodiversity and evaluation and assessment of the impacts in terms of their significance
- Identification/ proposing mitigation measures for minimizing the effects of the significant impacts.

After exclusion of the negligible impacts, the remaining aspects were assessed based on the following criteria:

- Magnitude of the impact;
- Duration: period of time that impact lasts;
- Mitigation measures; its availability whether integrated in the project design or implemented as management measures; and

- Residual impacts.

Where negative environmental impacts are expected, majority of them will be experienced during the construction phase. To help manage the potential negative impacts, mitigation measures are suggested and the residual impact evaluated.

b) Ecological Data Analysis

Extensive biodiversity inventory was used to determine the Level of Concern Category (LCC) for the proposed Solar Farm site. This is the level at which using the information available, a decision is made about the vulnerability of the species and habitats where they occur. The LCC is determined by combining the extent of the project coverage, expected magnitude of impacts, duration of the anticipated impact and probability of occurrence of the impact. Three levels of sensitivities were used in this assessment i.e.; **Low** (Where this impact would not have a direct influence on the decision to develop the project in the area); **Medium** (Where the impact could influence the decision to develop the project in the area unless it is effectively mitigated) and **High** (Where the impact will have an influence on the decision process to develop the project).

In order to achieve minimum impacts on biodiversity from the project, the Consultant applied the mitigation hierarchy recommended by Bennun et al 2021. A sequence of actions intended to avoid, and where avoidance is not possible, to minimize and, when impacts occur, to restore, and where significant residual impacts remain, offset.

c) Socioeconomic Analysis

Descriptive statistics such as percentages and frequencies have been used to demonstrate the distribution of respondents according to such variables as age, gender, marital status, and level of education, economic activities / occupation, access to basic social and infrastructural amenities and their preferred livelihood restoration strategies and resettlement sites. The analysed data have also been presented in form of pie charts and bar graphs that can quickly illustrate the study findings or data distribution. The qualitative data were transcribed and analysed manually with a view to developing emerging patterns and concepts to describe and explain relationships, trends, preferences, and processes in the study areas.

1.8 ESHIA Study Team

A summary list of the members of the ESHIA Team is given in **Table 4** below.

Table 4: List of Members of the ESHIA Study Team

#	Names	Position
A)	**Project Management**	
1.	Mr Richard Okello	Project Manager
B)	**Environmental & Socioeconomic Survey/Stakeholder Consultations**	
2.	Mr Joshua Oyieko	Team Leader/Environmental Lead Expert
3.	Mr Philip Abuor	Environmental Lead Expert
4.	Ms Jane O. Ogonji	Sociologist
5.	Dr Dan Adino	Sociologist
6.	Mr Moses Kololo	Environmentalist
C)	**Terrestrial Ecology Studies**	
7.	Dr Ronald K. Mulwa	Conservation Ecologist
8.	Dr Simon Musila	Mammologist

#	Names	Position
9.	Mr Victor Wasonga	Herpetologist (Reptiles & Amphibians)
10.	Ms Grace Kioko	Entomologist
11.	Mr Kennedy Matheka	Botanist
12.	Ms Janice Ella Atieno	Research Assistant (RA)
13.	Mr Edward Ayacko	Environmentalist/RA
14.	Mr Jerry Onyango	Research Assistant (RA)
15.	Mr Omummitah Agwaro	Research Assistant (RA)
D) Physical Cultural Resources Assessment		
16.	Dr Emmanuel Ndiema	Archaeologist
E) Sampling and Onsite Measurements		
17.	Ms Mariam Athman	Associate Environmental Expert
18.	Mr Calvince Odhiambo	Associate Environmental Expert
F) Technical Backstopping		
19.	Mr Fredrick Maseno	Safety and Occupational Health Expert
20.	Mr Murunga A. Kubondo	Electrical Engineer/Energy Expert

1.9 Structure of the Report

This ESHIA Study Report comprises of the following:

- Executive Summary;
- Chapter 1: Introduction;
- Chapter 2: Project Description
- Chapter 3: Policy, Legal and Administrative Framework;
- Chapter 4: Baseline Environmental and Social Conditions;
- Chapter 5: Analysis of Project Alternatives
- Chapter 6: Public and Stakeholder Consultations and Disclosure
- Chapter 7: Significant Environmental & Social Impacts and Mitigation Measures
- Chapter 8: Environmental, Social and Health Management and Monitoring Plans;
- Chapter 9: Community Development Action/Framework
- Chapter 10: Conclusions and Recommendations;
- Bibliography;
- Appendices

2 PROJECT DESCRIPTION AND PHYSICAL ENVIRONMENT

2.1 Nature of the Project

The proposed Solar PV Power Plant is going to generate 5MW of Solar Power that will be evacuated through a 2km Transmission Line to an existing substation within the Nairobi Grinding Plant. The generated power will solely be used by Bamburi Cement PLC for its operations.

2.2 Land Ownership and Use

2.2.1 Land Ownership

The land where the proposed Solar PV Power Plant is going to be located is within the unfenced parcel of land belonging to Bamburi Cement PLC. The proof of land ownership is provided under **Appendix 10.**

2.2.2 Land Use

The land was previously excavated as material source site. Bamburi has also been using it to store raw materials on the Southern side for the Grinding Plant. Since the site is not fenced the middle section has been used by the public to dump hazardous waste including biomedical, construction and disused asbestos roofing materials. Impacts and mitigation measures have been elaborated under **section 7.4.1.**

The proposed use of the land for installation of a Solar PV Power Plant is therefore deemed a better land-use option for the area provided the designs implement the recommended mitigation measures for minimizing negative impacts on flora and fauna.

2.3 Project Design

2.3.1 Project Components

Components

The preliminary design shows that the Solar PV Power Plant located at Bamburi in Athi River will have the following components:

Solar PV Modules

The Plant will use a total of 7,938 modules covering an area of 35,457m^2 (approx..3.55 Ha)

Available Land Area for the Solar Plant

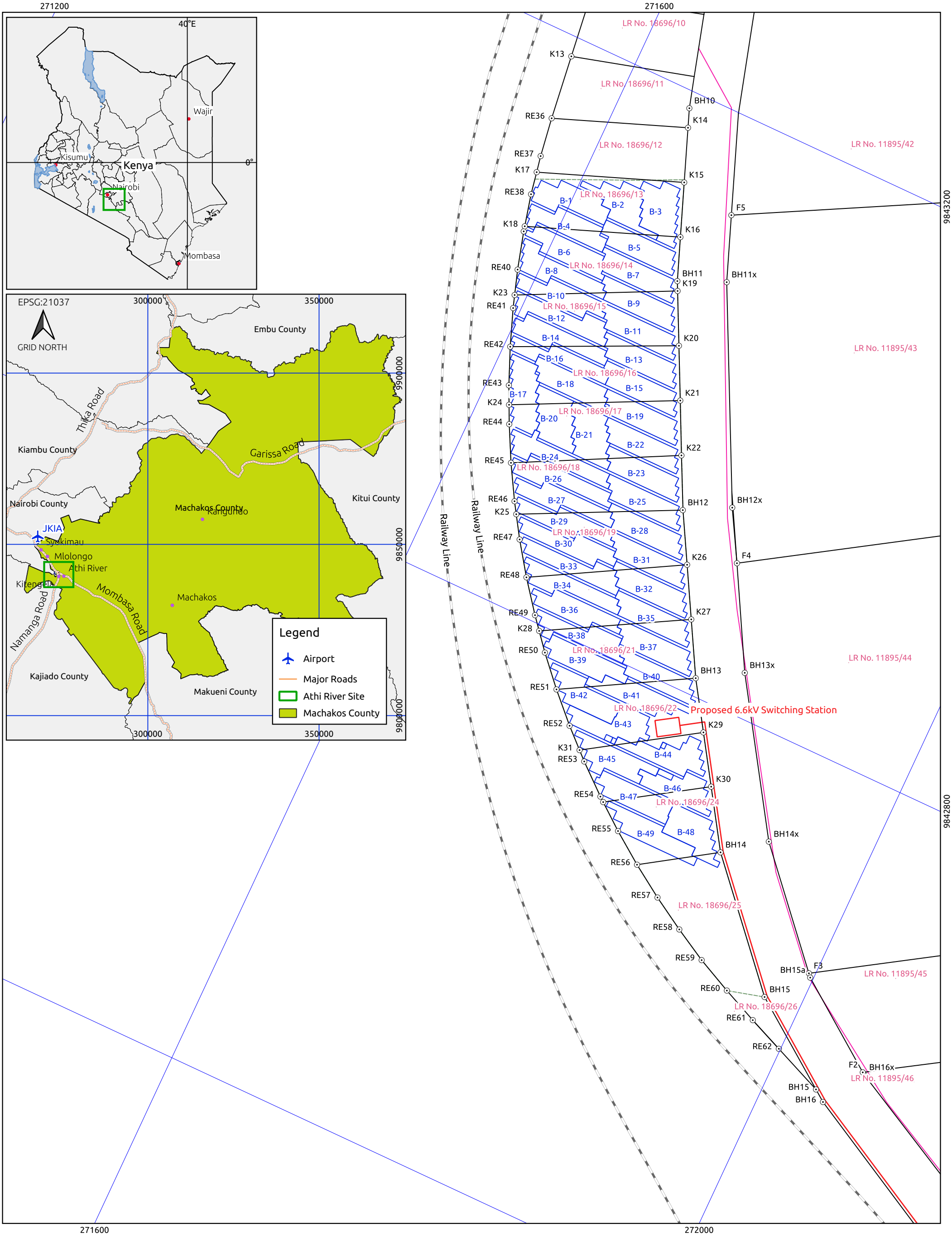
The available land for the Athi River Solar PV Power Plant is approx. 7.45Ha

Inverters

The Plant will use 50 inverters that will convert the DC current to AC with an operating voltage of between 600-1,500v.

Transformers

The Plant will use a total of 2 (2500kVA 6.6/0.4kV) Transformers.



Environmental, Social and Health Impact Assessment for Proposed Momnai Solar Farm Power Project at Athi River

Map Sheet 3 : Proposed Athi River Power Plant - Design Layout

50 0 50 100 150 m

EPSG:21037

Grid North

LEGEND

- Transmission Line
- Cadastral Boundary
- Proposed Fence Line
- Solar Panels Blocks
- Switch Station

2.3.2 Description of Procedure

Description of procedure
- Installation of the Solar Equipment
- Power Generation
- Transmission and Connection to the Substation

2.3.2.1 Installation of the Solar Equipment

The design under review is a fixed tilt ground mount system. The key solar equipment is:
- 15,876X Longi LR4-72 HPH 435 M Solar PV modules each rated at 435 Watts (peak). The module dimensions are 2094 mm by 1038 mm. The thickness is 35 mm.
- 50X Huawei SUN2000-100KTL-H1 inverters each rated at 100 KW (ac).

The Solar PV modules are to be mounted on a total 40 sheds. Each shed will have an east facing wing and a west facing wing. The two wings will be equal with each having a width of 6.45 M. One way of laying out the sheds to accommodate all the 15,876 Solar PV modules is to have 2 sizes of sheds.
- The first set of 26 sheds will have a length of 68 M. Each of these can accommodate 378 modules. The arrangement is 2 sides by 3 rows by 63 columns (2X3X63=378). These will be arranged in 14 strings.
- The second set of 14 sheds will have a length of 68 M. Each of these can accommodate 432 modules. The arrangement is 2 sides by 3 rows by 72 columns (2X3X72=378). These will be arranged in 16 strings.

The spacing from shed to shed is 14.5 M and thus the resulting ground coverage ratio (GCR) is 44.5 %.

2.3.2.2 Power Generation

The transformer pads will be located so as to minimise HV (6.6 KV) cabling. Each of the 2.5 MVA transformers are placed on prepared concrete plinth. Next to the transformer is the incoming LV panel that can support 25X inverters incomers (each 100 KW, 415 Volts).

The following steps are necessary to connect the power generation equipment:
- AC cabling is laid in the AC cable trench to connect the inverter to its position on the LV (Low Voltage) busbar at the 2.5 MVA transformer station.
- The LV busbar is then connected to the LV side of the 2.5 MVA transformer.
- The MV (Medium Voltage) side (6.6 KV) of the transformer is connected to the HV busbar.

A connection is then made from transformer at ST2 to the MV busbar of the transformer.

2.3.2.3 Transmission and Connection to the Substation

The main issue with transmission is to ensure that the transmission line is confined within Bamburi land.
The following steps are necessary for this connection:
- Secure a way leave
- If an underground cable will be used, then a trench is dug and the armoured 6.6 KV cable is placed in the trench which is then covered and the route marked.

- If it will be an overhead line, then the route is surveyed and holes are dug for the transmission poles. After the poles are installed, the line fixtures are installed, then the line can be installed.
- The line is then connected to the MV (6.6 KV) busbar at ST1.
- A new 25 MVA (6.6 KV/66 KV) transformer is installed at the main Bamburi (66KV) substation.
- The 6.6 KV line is terminated on the MV panel of the 25 MVA transformer.
- The 66 KV side of the transformer is connected to the 66 KV side of the Bamburi substation.
- The necessary high voltage side is connected to the metering device which is used as part of the control system to limit the amount of solar power that can be exported to the grid.

2.3.2.4 Ancillaries and control system

The other systems and equipment that may be necessary include

- A control system that monitors all the inverters on site plus the power flows at the point of interconnection. This control system will prevent unwanted back feed (into the grid) and will provide monitoring data and remote access.
- A maintenance office and maintenance equipment.
- A security system made up of fencing and CCTV
- Fire safety system

2.3.3 Power Evacuation

Power from the plant will be evacuated southwards to the Substation located within the Nairobi Grinding Plant via approx. 2km long 6.6kVkV Transmission line with a wayleave corridor of 10m.

2.3.4 Associated Facilities

The associated facilities to the Solar PV Power Plant include the following:

- ***Access Road to the Site*** – The site abuts a permanent road on the eastern site. This road will be used to directly access the site from the eastern side.
- ***Transmission Line for Evacuation of Power*** - The 2km long 6.6kVTransmission Line that will be evacuating Power from the Solar Plant
- ***Existing Substation at Nairobi Grinding Plant, Athi River-*** The existing substation within the Nairobi Grinding Plant site where the evacuated power from the Solar Plant will be connected.
- ***Scrap/Waste Yard*** - The scrap yard will also be present within the site; The scrap yard will consist of discarded panels and other hardware components such as wood/steel, oil barrels, wires/cables and domestic components.

2.3.5 Project Footprint Area

The Project Footprint is the area that may reasonably be expected to be physically touched by Project activities, across all phases. Physically, there is no demarcation of fencing for the Project Site boundaries and hence it is contiguous with the rest of the area.

2.3.6 Project Area of Influence (AoI)

The effects of the Project activities on a particular resource or receptor will have spatial (distance) and temporal (time) dimensions.

Some activities would impact a larger radius than other identified impact sources. The spatial and temporal dimensions have therefore been taken into account to define a Project's Area of Influence. Refer to **Map 4**.

The Project Area of Influence (AoI) for different environmental and social receptors is provided in **Table 5** below.

Table 5: Project Area of Influence

#	Environmental and Social Issues	Area of Influence	Justification
1	**Air Quality**	500 m	Dust emissions, fugitive dust, etc. is typically observed within 100-200m from the construction/operation area. A minimum of 500m AoI has been taken to capture all sources of these emissions including vehicle movement across access roads
2	**Noise Pollution**	500 m	Noise can often be detected up to 400-500m from any operation
3	**Water Environment**	500 m	Water body located in the vicinity of the project area may get impacted due to activities at project footprint. The nearest surface water body is approx. 500m from the site on the eastern side.
4	**Land Environment**	500 m	Impacts on soil and land are often restricted to the Project footprint area. An AoI of 500m taken into account indirect effects usually occur due to vehicle/ heavy machinery movements and activities at the site
5	**Socio-economic Conditions**	5 km	An AoI of 5 km radius is considered for socio-economic consultations to determine perceived impacts due to the Project including employment opportunities etc.
6	**Ecology**	5 Km	An AoI of 5 km radius is considered for the ecological study. The 5 km radius provides an understanding use of forested habitat around the proposed Nairobi National Park (fence line is approx. 70m from the site)

2.3.7 Core and Buffer Zones

The AoI defined above has been divided into a core and buffer zone:

Core Zone: The core zone is defined as the radius extending from the Project footprint area which would have majority of the impacts (during mobilization, construction, operation and decommissioning phase)**.** The core zone area for the study is project foot print area and adjacent area within 500 m radius.

Buffer Zone: the buffer zone of the study area is in general 5 Km radius from the proposed project site.

267500 270000 272500 275000

9847500 9845000 9842500 9840000 9837500

Syokimau
Mlolongo
Nairobi County
Kenya Nutritionists & Dieticians Institute
Mlolongo Primary Sch.
St. Augustine Mlolongo Sec. Sch.
Donga
Bomaa
Machakos County
Nairobi National Park
Solar Power Plant Development Area
Mbagathi
500m Buffer
1000m Buffer
Shalom Community Hospital
Athi
2500m Buffer
Masai Technical Training Institute
Athi River
Kitenkela
Naisula Springs School
Noonkopir Girls High School
NITA Government College
5000m Buffer
Kajiado County
Kitengela
Stony Athi

267500 270000 272500 275000

Environmental, Social and Health Impact Assessment for Proposed Momnai Solar Farm Power Project at Athi River

Map Sheet 4 : Proposed Athi River Power Plant - Project AOI

LEGEND
- River
- Project Development Area
- Buffer Zone

1 0 1 2 3 km

EPSG:21037
Grid North

2.4 Project Inputs

2.4.1 Environment, Health and Safety (EHS)

The contractor and the supervising consultant will engage a full time Environment, Health and Safety Specialist (EHS). The implementation of the management plans and corrective actions will be the responsibility of the EHS specialist. During construction and operation phases, site EHS specialist will supervise third parties to implement the management action plans in coordination with site manager.

Environment, Social, Health and Safety Management System (ESHS) Committee
ESHS committee will be formed at project management level to review the performance of project on environmental, health, safety and social aspects. Regular updating of ESHS Committee will be the responsibility of the ESHS Officer in addition to supporting the project management to achieve the goals as committed in the Policy. ESHS committee will be formed consisting of one member from HR, Finance, Project and Quality Health, Safety and Environment (QHSE) departments. The QHSE Head will be the ESHS coordinator for implementing this ESHS and will be interfacing with several other departments to ensure smooth and efficient functioning of the ESHS.

2.4.2 Construction Machines/Equipment

Table 6 shows some of the main construction machines required for construction of solar plant.

Table 6: Main Construction Machines/Equipment

Type	Type
Truck	Excavator
Truck with crane	Welding machine
Concrete mixing machine	Light truck
Power shovel	Cutting machine
Back hoe	Water tank truck

2.4.3 Solar Panels and other Accessories

The photovoltaic power plant will generate electricity using the sun's energy by means of 7,938 PV modules that will convert the solar irradiation into Direct Current (DC). The generated DC will be fed into inverters at the plant and the Alternating Current (AC) electricity evacuated via the 2km long 6.6kV Transmission Line to the Substation in Nairobi Grinding Plant**.**

2.4.4 Water Requirement

The installation and operation activities of the Solar Farm will require a significant quantity of water. Water will be required during the construction of the foundation structure and office building access road within the site. Water requirement for construction activities will be determined after finalization of the detail design. It is estimated that during operation, each event of cleaning the 7,938 modules will be 15,876 litres assuming each module requires 2 litres. Depending on the level of dust in the project area, cleaning may be required as often as every month escalating the water demand to 190,512 litres.

An alternative source of water (borehole) will therefore be needed since the project area is water stressed. Refer to section 3.2.9 for requirements for sinking a borehole.

2.4.5 Oil

During construction, there will be unused and used oil recovered from machinery and vehicles including oil filters and oil rugs. These hazardous materials will need to be kept in paved areas with containment to avoid impact to soil and groundwater.

2.4.6 Security

The construction and operations activities of the Solar Power Plant will be carried out in unfenced area and therefore full-time security will be required for the infrastructure.

2.4.7 Labour

The project will require both skilled and unskilled labour during construction and operation phases of the project. This will result in migrant labour influx that could trigger Community Health and Safety risks. There will be need to put in place a labour influx management plan and conduct labour influx risk assessment with focus on the key impacts on local community. Workers (e.g., masons, supervisor, unskilled laborers) are expected daily to be working at the solar plant site. Most workers will be sourced locally, although skilled workers may be hired for highly technical works. The entire recruitment process of the workers will be managed by the contractors in accordance with Kenya labor laws following guidance of the Labour Influx Plan. Normal working hours are planned to be from around 08:00-17:00 from Monday to Saturday. Works outside of normal working hours will be sought from the relevant local authorities.

2.5 Project Outputs

2.5.1 Power

The Solar Plant will have the capacity to generate 5MW of power. The generated power will be converted to AC through inverters at the plant and directly evacuated through the 2km long 6,6 kV Transmission Line to the substation located within the Nairobi Grinding Plant. There will be no storage of power at the Solar Plant.

2.5.2 Surface Runoff Water

The solar panels may increase the quantity of surface runoff water with the potential to cause erosion and pollution of facilities in the project neighbourhood if not well controlled.

2.6 Project Schedule and Phasing

The project activities are divided into five phases as listed below:

a) Pre-Construction (Preparation Activities);
b) Construction;
c) Operation (including maintenance and repair);
d) Decommissioning.

a) Pre-Construction (Preparation Activities)

Before construction activities of the Solar PV Power Plant commences, the site will be prepared. Site preparation activities will involve erection of a perimeter fence, removal of raw material, the hazardous waste located in the middle section of site (a Hazardous Waste Management Plan will need to be prepared by the Contractor and used to remove the waste before activities commence at the site), vegetation clearance, levelling and grading of the land. There will also be mild excavation works and transportation of materials. Access roads are already available and in use. There is a major Road (Old Nairobi-Mombasa Rd) passing next to the site. The site requires fencing to avoid further dumping of hazardous waste. Details on Hazardous Waste Management is provided under section 7.4.1.

b) Construction Activities

Bulky materials such as metallic structure of the trackers will be carefully piled at designated areas of the site. In order to avoid piling large quantities of materials on site, delivery of such bulky materials will be done in required quantities. Where feasible delivery will be timed to coincide with the time of installation. Construction activities will involve the following:

- Construction of site office and amenities, equipment and supplies storage areas, and waste pits;
- Excavations/earth moving, filling and foundation laying for the PV module,
- Foundation laying for ground mounted structures;
- Transportation of equipment including PV module, mounting structure,
- Completing internal electrical connections of PV module;
- Building works, trampling and removal of construction wastes,
- Installation of trackers and other components of the plant;
- Laying of internal electrical connections;
- Installation of inverter and transformers;
- Completion of the plant,
- Solid waste collection and commissioning of the plant.

c) Operation Activities

During the operation phase, the following project activities will be carried out:

- Regular (Monthly) cleaning of PV modules;
- The Control of vegetation like. weeds, bushes etc. within the site and the immediate surrounding it;
- Carry out Routine inspection of all PV modules and associated structures like cables, transformers, inverters, mounting structures etc;
- Operation and maintenance of ancillary facilities such as power substation; Inspection and maintenance of transmission lines;
- Inspection and maintenance of internal pathways and access roads.

d) Decommissioning Phase Activities

During decommissioning, there will be activities associated with the following

- Preparation of a project decommissioning plan;
- Restoration of material source areas;
- Removal and disposal of PV modules;
- Removal and disposal or reuse of ground mounted structures.

2.7 Existing Project Area Infrastructure

The Solar Plant site borders a permanent road (Old Nairobi-Mombasa Road) passing along the eastern boundary. The railway lines (SGR and Metre Gauge) are located to the west of the site.

The project area is fairly industrialized. There are other industries that are other industries which include Special Projects Factory to the immediate north of the site, Mabati Rolling Mills, Kenya Meat Commission, Agrichem & Tools, Athi River Steel Plant, Primarosa, Simba Cement, Bamburi Cement, Mombasa Cement, Ndovu Cement, East African Portland Cement, Savannah Cement, National Cement, Poly Tanks, Athi River Mining and Export Processing Zone (EPZ).

2.8 Project Budget

The proposed Solar PV Power Plant in Athi River is estimated to cost USD 5 Million.

3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 Policy Framework

The Republic of Kenya has a policy, legal and administrative framework for environmental and social management. The broad objectives of the policy are: -

- To ensure optimal use of natural resources while improving environmental quality.
- To conserve natural resources such that the resources meet the needs of the present without jeopardizing future generations in enjoying the same.
- To develop awareness that inculcates environmental stewardship among the citizenship of the country.
- To integrate environmental conservation and socio-economic aspects in the development process.
- To ensure that national environmental and social goals contribute to international obligations on environmental management and social integrity.
- To achieve the above policy objectives, it is directive that appropriate reviews and evaluations of all forms of developmental project plans and operations are carried out to ensure compliance with the environmental policy and legal frameworks.

The following section provides details of the relevant policies in the country.

3.1.1 Sessional Paper No. 10 of 2012 on Kenya Vision 2030

The Kenya Vision 2030 is a comprehensive national development plan for the period 2008 to 2030. The plan was developed following successful implementation of the Economic Recovery Strategy for Wealth and Employment Creation which ensured the country's economy was back on the path for realization of rapid economic growth since 2002. The country's GDP growth rose from 0.6% to 7% in 2007, but declined to 1.7% and 1.8% in 2008 and 2009, respectively. The objective of the Vision 2030 is to transform Kenya into a middle-income country with a consistent annual economic growth of 10 % by the year 2030. The 2030 goal for urban areas is to achieve "a well-housed population living in an environmentally-secure urban environment." This goal is expected to be achieved by developing basic infrastructure services such as roads, street lights, water and sanitation facilities, storm water drains, footpaths, and others while ensuring that the country has a clean, secure and sustainable environment by 2030 through reduction of pollution and improvement of waste management.

The proposed Utility Solar PV Power Plant will contribute to the realization of the goals of Vision 2030 through provision of clean, reliable and efficient green energy and improvement of human health among others.

3.1.2 Sessional Paper No. 10 of 2014 on the National Environment Policy

The policy seeks to provide the framework for an integrated approach to planning and sustainable management of natural resources in the country. It recognizes the various vulnerable ecosystems and proposes various policy measures not only to mainstream sound environmental management practices in all sectors of society throughout the country but also to recommend strong institutional and governance measures to support achievement of desired objectives and goals. **Section 5.6.1** emphasizes that the environment aspects of such infrastructural developments are distinct and unique such as effects on flora and fauna, social and psychological disruption, vegetation clearance, excavation works and spillages during construction. **Section 5.9** on energy use emphasizes that the Government will develop and promote an integrated national strategy for generation and sustainable utilization of renewable energy.

The Policy also emphasizes that environmental education and public awareness should be promoted at all levels and there should be inclusion of cross-cutting and emerging issues such as poverty reduction, gender, disability, HIV&AIDS and other diseases in the management of the environment and natural resources: It calls for:

- Sustainable use of freshwater and wetland resources and the conservation of river and lake ecosystems. It calls for involvement and empowerment of communities in conservation and protection of endangered plants and wildlife species, management of forest, freshwater and Wetland ecosystems;
- Development and promotion of integrated national strategy for generation and sustainable utilization of renewable energy and emphasizes that all significant development projects are subjected to EIA and regular environmental audits.

ESHIA has been carried and the project will need to adhere to the requirement of regular audit as required by NEMA.

3.1.3 The National Biodiversity Strategy of 2000

The National Biodiversity Strategy and Action Plan (NBSAP) was formulated to enable Kenya address national and international commitments defined in Article 6 of the Convention on Biological Diversity (CBD). The strategy is a national framework of action for ensuring that the present rate of biodiversity loss is reversed, and present levels of biological resources are maintained at sustainable levels for posterity.

The general objectives of the strategy are to conserve Kenya's biodiversity; to sustainably use. its components; to fairly and equitably share the benefits arising from the utilization of biological resources among the stakeholders; and to enhance technical and scientific cooperation nationally and internationally, including the exchange of information in support of biological conservation.

The proposed Solar PV Power Plant will need to comply with the requirements of this strategy since the project may lead to loss of biodiversity in some areas. An in-depth biodiversity assessment has been carried out on the site to understand the biodiversity status, of the proposed site to identify potential impact of construction and operation of the Solar Plant and to identify mitigation / enhancement measures. Based on the assessment, a Biodiversity Management Plan has been prepared and forms part of this ESHIA Report and will form part of the works contract to meet the commitment under NBSAP and to satisfy critical habitat requirement under IFC PS 6.

3.1.4 Sessional Paper No. 3 of 2009 on National Land Policy

The Land Policy in Kenya is guided by the environmental management principles which are aimed at restoring the environmental integrity through introduction of incentives and encouragement of use of technology and scientific methods for soil conservation, among others. The policy further requires fragile ecosystems to be managed and protected by developing a comprehensive land use policy bearing in mind the needs of the surrounding communities. The policy also requires zoning of catchment areas to protect them from degradation and establishment of participatory mechanisms for sustainable management of fragile ecosystems. The policy also called for development of procedures for co-management and rehabilitation of forest resources while recognizing traditional management systems and sharing of benefits with contiguous communities and individuals. Lastly, all national parks, game reserves, islands, front row beaches and all areas hosting fragile biodiversity are declared as fragile ecosystems under the policy.

The policy recognizes that sustainable management of land based natural resources depends largely on the governance system that defines the relationships between people, and between people and resources. To achieve an integrated approach to management of land-based natural resources, all policies, regulations and laws dealing with these resources need to be harmonized with the framework established by the Environmental Management and Coordination Act (EMCA Cap 387). The policy also addresses land management on ecosystem protection (including wetlands). Measures for protection are required for fragile ecosystems. The policy also calls for the protection of watersheds, lakes, drainage basins and wetlands. The policy prohibits settlement and agricultural activities in water catchment areas and calls for identification, delineation and gazettement of all water courses and wetlands.

*There are rivers within the AoI (Refer to **Map 4**). The proposed Solar Plant has potential of impacting soils in the project area which may be washed off to the nearby stream (500m east of the site) that feeds into Athi River. It is important to undertake appropriate mitigation measures to minimize or avoid degradation of wetlands.*

3.1.5 Wildlife Policy of 2011

The wildlife policy is aimed at promoting protection and conservation of wildlife in Kenya, both in protected and non-protected areas. The policy is implemented by the Kenya Wildlife Service (KWS).

The proposed Solar PV Power Plant will need to be consistent with this policy. Since the biodiversity (birds, small mammals, reptiles, amphibians, insects etc) occurring at the site will be disturbed during the construction and operation of the facility, appropriate mitigation measures must be implemented to minimize disturbance to wildlife.

3.1.6 Wetlands Policy of 2013

The wetlands policy is intended to promote protection of wetlands in Kenya. The policy sets out strategic measures for the protection of existing wetlands.

*There is a stream (500m east of the site) within the AoI (Refer to **Map 4**). The proposed Solar Plant has potential of impacting water resources in the project area. It is important to undertake appropriate mitigation measures to minimize or avoid degradation of wetlands.*

3.1.7 Public Health Policy of 2014

The public health policy calls upon the project proponents to ensure that buildings are adequately provided with utilities so that they are fit for human habitation.

The site office must be provided with all amenities/utilities that are essential for safeguarding public health for all people using the facilities.

3.1.8 Occupational Health and Safety Policy of 2012

This policy is intended to protect safety and health of workers in work places. The proposed Solar PV Power Plant will provide employment opportunities to many workers in various categories during construction and operation.

The contractor will be expected to comply with the requirements of this policy when engaging workers in various construction activities. The environmental management provides mitigation measures that can be undertaken to ensure compliance with the requirements of this policy.

3.1.9 HIV/AIDS Policy of 2009

The policy identifies HIV/AIDS as a global crisis that constitutes one of the most formidable challenges to development and social progress. The Pandemic heavily affects the Kenyan economy through loss of skilled and experienced manpower due to deaths, loss of man hours due to prolonged illnesses, absenteeism, reduced performance, increased stress, stigma, discrimination and loss of institutional memories, among others.

Due to the large number of workers who will be involved in the project and the associated social issues with projects of such as scale, HIV/AIDS has been considered as one of the potential impacts, but adequate mitigation measures have also been proposed to that effect.

3.1.10 Kenya National Policy on Gender and Development (NPGD), 2000

The purpose of the Gender Policy is to institutionalize The Kenya National Policy on Gender and Development (NPGD) within Gender, Children and Social Development. It articulates the policy approach of gender mainstreaming and empowerment of women at the ministry level. The policy seeks a society where women, men, children and persons with disabilities enjoy equal rights, opportunities and a high quality of life.

This report has addressed matters to do with gender and development. The project shall be governed under this principle during the entire project period.

3.1.11 The Kenya National Climate Change Response Strategy of 2010

This strategy provides measures that the Government of Kenya is taking to address issues related to the impact of climate change on various sectors of the economy. The proposed Solar PV Power Plant is one of the renewable energy technologies that produces clean energy that reduces greenhouse gas emissions and other pollutants.

Solar PV Power Plant therefore will contribute to reduction of climate change effects.

3.1.12 The National Poverty Eradication Plan (NPEP) of 1999

The National Poverty Eradication Plan (NPEP) was formulated with an objective of reducing the high levels of poverty in Kenya by 50 percent by the year 2015, as well as to strengthen the capabilities of the poor and vulnerable groups to earn income. The plan also aimed at reducing gender and geographical disparities in order to create a healthy, better-educated and more productive population. The formulation of the plan was guided by the goals and commitments agreed during the World Summit for Sustainable Development (WSSD) of 1995.

The plan therefore focuses on the delivery of four WSSD themes of poverty eradication; reduction of unemployment; social integration of the disadvantaged people and creation of an enabling economic, political, and cultural environment through development of transport and communication sector. The plan is implemented by the Poverty Eradication Commission (PEC) that was established in collaboration with various Government Ministries, bilateral and multilateral donors, the private sector, Community Based Organizations (CBOs) and Non-Governmental Organizations (NGOs).

The NPEP is relevant since the proposed Solar Plant will create an enabling environment that will contribute immensely in the enhancement of economic growth in Kenya. The proposed project will also impact the construction industry and business in general thereby having great relevance to poverty eradication in the country.

3.1.13 The Poverty Reduction Strategy Paper (PRSP) of 2000

The Poverty Reduction Strategy Paper (PRSP) for Kenya has the broad objective of reducing poverty and promoting economic growth. This policy articulates Kenya's commitment and approach to tackling endemic poverty through involvement of the poor communities in both rural and urban areas in various socio-economic development activities.

The proposed project, during and after implementation will offer various employment opportunities to Kenyans and will therefore contribute directly towards the realization of the broad national goal of reducing poverty in the country. In addition, the project will stimulate economic development by directly contributing to the construction industry and other key sectors of the economy to thrive.

3.1.14 The National Energy and Petroleum Policy 2015

The overall objective of the energy and petroleum policy is to ensure affordable, competitive, sustainable and reliable supply of energy to meet national and county development needs at least cost, while protecting and conserving the environment. This policy stipulates the transformation of the Rural Electrification Authority (REA) into Rural Electrification and Renewable Energy Corporation (REREC) to be the lead agency for development of renewable energy resources other than geothermal and large hydro-power plants.

The proposed Solar PV Power Plant will aid in meeting this objective.

3.1.15 The Gender Policy 2011

The overall goal of this Policy Framework is to mainstream gender concerns in the national development process in order to improve the social, legal/civic, economic and cultural conditions of women, men, girls and boys in Kenya

The policy provides direction for setting priorities. An important priority is to ensure that all ministerial strategies and their performance frameworks integrate gender equality objectives and indicators and identify actions for tackling inequality. In addition, each program will develop integrated gender equality strategies at the initiative level in priority areas. Within selected interventions, the policy will also scale-up specific initiatives to advance gender equality.

This policy will be referred to during Project implementation especially during hiring of staff to be involved in the project, procuring of suppliers and sub consultants and sub-contractors to the project.

3.2 Legal Framework

The Republic of Kenya has numerous statutes that guide environmental management and conservation in the country. Most of these statutes are sector specific and cover a wide range of issues including public health, soil conservation, protected areas conservation, endangered species, public participation, water rights, water quality, air quality, excessive noise control, vibration control, land use, among others.

The main legislation is the Environmental Management & Coordination (Amended) Act (EMCA) of 2015. The Act emphases that every person in Kenya is entitled to a clean and healthy environment in accordance with the Constitution and relevant laws and has the duty to safeguard and enhance the environment. It also empowers stakeholders to participate in sustainable management of the natural resources. It calls for Environmental and Social Impact Assessment

(ESIA) to guide the implementation of environmentally and socially sound decisions. There are other relevant local laws and regulations that have been looked into. They include but not limited to, the Constitution, the Water Act of 2016, The County Government Act 2012 among others.

The other regulations, standards, guidelines and conventions that have been evaluated in relation to this project include:

- Applicable National Environmental Management, Occupational Health and Safety, Public Health and Labour laws and regulations;
- IFC Performance Standards;
- EIB Environmental and Social Standards;
- The World Bank Group EHS Guidelines; and
- International Labour Organization Conventions.

3.2.1 The Constitution of Kenya

Various issues related to environmental management have been taken on board in Constitution of Kenya. Article 42 of the Bill of Rights contained in the Constitution provides that '*every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures*.

Article 54 provides for the rights of persons with disability while Article 56 highlights the rights of marginalized groups to participate in the decision-making process with regards to developments, thus, highlighting the need for consultation during the ESIA process and during the implementation of the project. Article 60 elaborates on Land Policy that which emphasizes that land shall be held, used and managed in a manner that is equitable, efficient, productive and sustainable ensuring that there is:
(e) Sound conservation and protection of ecologically sensitive areas;
(f) Elimination of gender discrimination in law, customs and practices related to land and property in land;
(g) encouragement of communities to settle land disputes through recognized local community initiatives consistent with this Constitution.

Land classification is provided in Article 61 while Article 64 elaborates on Private Land ownership. Article 69 provides for the need to establish systems of environmental impact assessment, environmental audit and monitoring of the environment and public participation.
Chapter 5 of the new constitution provides the main pillars on which the 77 environmental statutes are hinged and covers "Land and Environment" and includes the aforementioned articles 69 and 70. Part 1 of the Chapter dwells on land, outlining the principles informing land policy, land classification as well as land use and property.

Part 2 of the Chapter directs focus on the environment and natural resources. It provides for a clear outline of the state's obligation with respect to the environment. The Chapter seeks to eliminate processes & activities likely to endanger the environment.

Article 69 states that the State shall:

- Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
- Work to achieve and maintain a tree cover of at least ten percent of the land area of Kenya;
- Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
- Encourage public participation in the management, protection and conservation of the environment;

- Protect genetic resources and biological diversity;
- Establish systems on environmental impact assessment, environmental audit and monitoring of the environment;
- Eliminate processes and activities that are likely to endanger the environment; and,
- Utilize the environment and natural resources for the benefit of the people of Kenya. 16

There are further provisions on enforcement of environmental rights as well as establishment of legislation relating to the environment in accordance to the guidelines provided in this Chapter.

In conformity with the Constitution of Kenya 2010, every activity or project undertaken within the Republic of Kenya must be in tandem with the state's vision for the national environment as well as adherence to the right of every individual to a clean and healthy environment.

Article 70 provides for enforcement of environmental rights thus: -:

- If a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress in addition to any other legal remedies that are available in respect to the same matter.
- On application under clause (1), the court may make any order, or give any directions, it considers appropriate —

  (a) to prevent, stop or discontinue any act or omission that is harmful to the environment; (b) to compel any public officer to take measures to prevent or discontinue any act or omission that is harmful to the environment; or

  (b) To provide compensation for any victim of a violation of the right to a clean and healthy environment.
- For the purposes of this Article, an applicant does not have to demonstrate that any person has incurred loss or suffered injury.

Essentially, the Constitution has embraced and provided further anchorage to the spirit and letter of the Environmental Management and Co-ordination Act (EMCA), 1999, whose requirements for environmental protection and management have largely informed Sections 69 through to 71 of the Document. In Section 72 however, the new constitution allows for enactment of laws towards enforcement of any new provisions of the Supreme Law.

The proposed project complies with the Constitution by proposing a framework in its ESHIA on Social, Health, Safety and Environmental protection.

3.2.2 Environmental Guidelines

In line with the Kenyan Constitution, NEMA has developed a number of guidelines which are part of a series of environmental management tools for environmental management under the Environmental Management and Coordination Act, CAP 387 of the Laws of Kenya. Below is a highlight of the key project relevant guidelines;

3.2.3 The Integrated Land Use Guidelines

Land in Kenya is a key factor of production, making its proper management a requirement for sustainable development.

The demand for arable land, grazing, forestry, wildlife, tourism and urban development are greater than the land resources available. These demands become more pressing every year with continued population growth. To address the identified key issues in land use management within a development-oriented approach poses challenges to all stakeholders and requires integrative solutions across the policy, socio-economic, and environment sectors.

the Integrated National Land Use Guideline is aimed at the prevention and mitigation of land degradation, addressing land use conflicts and managing both natural and anthropogenic disasters through the promotion of sustainable land management. It takes into account the provisions of the New Constitution of Kenya 2010 (specifically Chapter Five – Sections 60 - 72 which deal with "Land and Environment" as well as the various other laws, regulations, policies and guidelines in the different land sectors.

3.2.4 Technical Guidelines on the Management of used Oil and Oil Sludge in Kenya (NEMA, 2014)

The main objective of the guidelines is to ensure effective and efficient collection and transportation systems for used oil. These guidelines target government agencies (responsible for decision making, formulating policies and enforcing health and safety aspects of used oil and oil sludge management in the country), small generators, bulk generators of used oil and oil sludge, garages, used oil treatment plants, recycling and disposal facilities, and other interested stakeholders. The Proponent is envisioned to use heavy machinery which will require servicing hence producing used oil. These guidelines provide direction on safe management of used oil and oil sludge in Kenya and are a main regulatory reference material for management of used oil in Kenya and hence will be used as a key reference point to create awareness on hazards associated with handling used oil and to provide guidance on infrastructure for management of used oil.

3.2.5 Environmental Management and Coordination Act (EMCA, Cap 387)

The Environmental Management and Coordination Act (EMCA), 1999, is the framework law on environmental management and conservation in Kenya. Part II Article 3 of this Act states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. To achieve this goal, the projects listed under the Amended Second Schedule of EMCA, Legal Notice No. 31 of 2019 must be subjected to Environmental Impact Assessment (EIA). The Solar Power Plant is listed under **Medium Risk Category, Item 8 (f) Solar Power Farms or Plants**. The aim of the EIA is to reduce negative environmental outcomes of the listed projects by implementing mitigation measures. There are several other regulations that have been formulated within the framework of EMCA, that are applicable to the proposed project.

Under EMCA, NEMA has gazetted legal tools that govern conduct of EIAs and general environmental protection. The Proposed Solar PV Power Plant has been screened against these tools with results outlined below.

3.2.5.1 EMCA (Environmental Impact Assessment and Audit) Regulations, 2003

The Environmental (Impact Assessment and Audit) Regulations provides ESIA process for preparation of the EIA Project or Study Reports that have to be submitted to NEMA for review and issuance of EIA License. The regulations provide details on the aspects to be evaluated and ESMPs and Monitoring plans to be prepared.

The proposed project must comply with the requirements of the regulations that also include conducting regular monitoring and annual audits. The project requires an EIA license from NEMA before commencement of any activity.

3.2.5.2 EMCA (Water Quality) Regulations, 2006

The EMCA (Water Quality) Regulations, 2006 apply to water used for domestic consumption, industrial, recreation, fisheries, wildlife and irrigation, among others. The Contractor will be expected to provide water for consumption that meets the water quality standards as provided in the First Schedule of these regulations and provided in Table 1. The proposed project will need to comply with the requirements of this regulation to ensure water sources in the project area are protected from pollution and over abstraction. The project will also need to comply with the regulations that prohibit undertaking of development within a minimum of 6m from the highest ever recorded flood level of a river system. The regulation prohibits pollution of water bodies and requires that all substances discharged into the water bodies should meet the effluent discharge standards set under the Third Schedule of the regulations**.**

Table 7: Quality Standards for Domestic Water (NEMA)

No	Parameter	Guide Value (max allowable)
1	pH	6.5 – 8.5
2	Suspended solids	30 (mg/L)
3	Nitrate-NO_3	10 (mg/L)
4	Ammonia –NH_3	0.5 (mg/L)
5	Nitrite –NO_2	3 (mg/L)
6	Total Dissolved Solids	1200 (mg/L)
7	Scientific name *(E.coli)*	Nil/100 ml
8	Fluoride	1.5 (mg/L)
9	Phenols	Nil (mg/L)
10	Arsenic	0.01 (mg/L)
11	Cadmium	0.01 (mg/L)
12	Lead	0.05 (mg/L)
13	Selenium	0.01 (mg/L)
14	Copper	0.05 (mg/L)
15	Zinc	1.5 (mg/L)
16	Alkyl benzyl sulphonates	0.5 (mg/L)
17	Permanganate value (PV)	1.0 (mg/L)

Source: Water Quality Regulations - 2006 (NEMA)

3.2.5.3 EMCA (Fossil Fuel Emission Control) Regulations, 2006

The EMCA (Fossil Fuel Emission Control) Regulations, 2006 aims at eliminating or reducing emissions emitted from internal combustion engines to acceptable levels. The regulation provides guidelines on use of clean fuels, use of catalysts and inspection procedures for engines and generators. This regulation is applicable to the proposed project since there will be use of vehicles, machinery and equipment that depend on fossil fuel as their source of energy. The requirements of the regulation must be implemented to eliminate or reduce air quality degradation. Sections of the regulation citing the standards of recommended emission levels will be given to the contractor and or pinned at strategic points in the contractor's field offices.

3.2.5.4 EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006

The EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 provides that no person shall engage in any activity that may have an adverse impact on any ecosystem; may lead to the introduction of any exotic species or to unsustainable use of natural resources, without an Environmental Impact Assessment License issued by the Authority under the Act. The regulation requires NEMA in consultation with the relevant lead agencies, to impose bans, restrictions or similar measures on the access and use of any threatened species to ensure its regeneration and maximum sustainable yield. The proposed Solar PV Power Plant is located in an area with diverse ecosystems which will need to be protected as per the requirements of this regulation.

3.2.5.5 EMCA (Waste Management Regulations, 2006)

The Waste Management Regulations are basically aimed at streamlining the handling, transportation and disposal of various types of wastes. The broad goal of the regulations is to protect human health, wildlife and the environment. The regulations will be critical during the construction phase of the project when various wastes will be generated. Since there will be both ordinary and hazardous (used oil and hydraulic fluid) wastes generated, the Contractor will be expected to engage a NEMA registered/approved waste collection firm to manage the transportation and disposal of waste.

The Contractor will follow the Waste Management Plan to carry out segregation, storage, transportation and disposal of waste at all the operational areas (Office, Workshop area and Construction site).

Table 8: Waste Management Regulations

	PART II – GENERAL PROVISIONS
Responsibility of Waste Generator	(1) No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. (2) Any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed off such waste in the manner provided for under these Regulations. (3) Without prejudice to the foregoing, any person whose activities generates waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose off such waste in a designated waste disposal facility.
Segregation of Waste by Generator	5. (1) Any person whose activities generate waste, shall segregate such waste by separating hazardous waste from non-hazardous waste and shall dispose of such wastes in such facility as is provided for by the relevant Local Authority.
Cleaner Production Principles	6. (1) Any person who owns or controls a facility or premises which generates waste shall minimize the waste generated by adopting the following cleaner production principles: improvement of production process through: conserving raw materials and energy (ii) eliminating the use of toxic raw materials within such time as may be prescribed by the Authority (iii) reducing toxic emissions and wastes monitoring the product cycle from beginning to end by: identifying and eliminating potential negative impacts of the

	product. (ii) enabling the recovery and re-use of the product where possible. (iii) reclamation and recycling. (c) incorporating environmental concerns in the design, process and disposal of a product.
Waste Transportation *Licence*	7. (1) No person shall be granted a licence under the Act to transport waste unless such person operates a transportation vehicle approved by the Authority upon recommendation from the relevant lead agency. Any vehicle used for transportation of waste or any other means of conveyance shall be labelled in such a manner as may be directed by the Authority. The Authority in consultation with the relevant lead agency may designate particular geographical areas as areas for operation for licensed waste transporters. The application for a licence to transport waste shall be in Form I of the First Schedule to these Regulations and shall be accompanied by the prescribed fee set out in the Second Schedule. A licence issued under the Act for the transportation of waste shall be in Form II of the First Schedule to these Regulations and shall be valid for one year from the date of issue.
Mode of transporting waste.	A person granted a licence to transport waste shall ensure that: (1) the collection and transportation of such waste is conducted in such a manner that will not cause scattering, escaping and/or flowing out of the waste; (2) the vehicles and equipment for the transportation of waste are in such a state that shall not cause the scattering of, escaping of, or flowing out of the waste or emitting of noxious smells from the waste; (3) the vehicles for transportation and other means of conveyance of waste shall follow the scheduled routes approved by the Authority from the point of collection to the disposal site or plant; and (4) he or his agent(s) possess at all times during transportation of the waste, a duly filled tracking document as set out in Form III of the First Schedule to these Regulations and shall produce the same on demand to any law enforcement officer.
Transportation of waste by licensed transporter	9. Any person licensed to transport waste shall collect waste from the designated area of operations or storage areas and shall deliver such waste to the designated storage site, disposal site or plant.
Transitional Provision for transporting waste	10. Any person, who before the commencement of these Regulations was carrying on the business of transporting waste, shall apply to the Authority for a licence for the transportation of waste within ninety days after the commencement of these Regulations in the prescribed Form I as set out of the First Schedule to

	these Regulations.
Licence for disposal facility	11. (1) Any person granted a licence under the Act and any other licence that may be required by the relevant Local Authority to operate a waste disposal site or plant, shall comply with all conditions imposed by the Authority to ensure that such waste disposal site or plant operates in an environmentally sound manner. (2) An application for a licence to operate a waste disposal site or plant shall be in Form IV of the First Schedule to these Regulations and shall be accompanied by the prescribed fee set out in the Second Schedule. A licence issued under the Act for the operation of a waste disposal site or plant shall be as in Form V as set out in the First Schedule to these Regulations.
Transitional Provision for disposal facilities	12. Any person who before the commencement of these Regulations was carrying on the business of operating a waste disposal site or plant shall apply to the Authority for a licence as prescribed in these Regulations within ninety days after the commencement of these Regulations.
Waste treatment by operators of disposal sites. Cap 265	13. Any operator of a disposal site or plant shall apply the relevant provisions on waste treatment under the Local Government Act and Regulations thereunder to ensure that such waste does not present any imminent and substantial danger to public health, the environment and natural resources.
Validity of license and renewals	14. A licence to operate a waste disposal site or plant shall be valid for a period of one year from the date of issue and may be renewed for a further similar period on such terms and conditions as the Authority may deem necessary or impose for purposes of insuring public health and sound environmental management.
Requirement for Environmental Audit	15. Every licensed owner or operator of a waste disposal site or plant shall carry out an annual environmental audit pursuant to the provisions of the Act.
Re-use and recycling plants	16. Notwithstanding any provisions to the contrary herein, these Regulations shall apply to plants and sites established for re-use or re-cycling of wastes.

3.2.5.6 EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009

The Environmental Management and Co-ordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009 applies to all wetlands in Kenya whether occurring in private or public land. The objectives of the regulations are to provide for the conservation and sustainable use of wetlands and their resources.

*There are rivers within the AoI (Refer to **Map 4**). The proposed Solar Plant has potential of impacting wetlands on the project area. It is important to undertake appropriate mitigation measures to minimize or avoid degradation of wetlands.*

3.2.5.7 EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2009

This regulation prohibits generation of excessive noise and vibration in habited areas. These Regulations determine the level of noise that will permissible in particular during the construction of the improvements, the following factors will be considered:

- Time of the day;
- Proximity to residential area;
- Whether the noise is recurrent, intermittent or constant;
- The level and intensity of the noise;

- Whether the noise has been enhanced in level or range by any type of electronic or mechanical means; and,
- Whether the noise is subject to be controlled without unreasonable effort or expense to the person making the noise.

The Contractor will be expected to meet the noise level requirements as provided in the following schedules of the regulations and also carry out noise level monitoring:

- Schedule 1 – Noise levels at residential and commercial sites – Table 9
- Schedule 2 – Noise levels at Construction sites – Table 10
- Schedule 3 – Noise Levels at quarry sites

Noise permits may be required in blasting areas given that the project area is habited and wildlife is also present.

Table 9: Maximum Permissible Noise Levels – Residential and Commercial (NEMA)

Zone		**Sound Level Limits dB(A)**		**Noise Rating Level (NR) (Leq,14 h)**	
		Day	Night	Day	Night
A.	Silent Zone	40	35	30	25
B	Places of worship	40	35	30	25
C.	Residential: Indoor Outdoor	45 50	35 35	35 40	25 25
D.	Mixed residential (with some Commercial and places of entertainment)	55	35	50	25
E.	Commercial	60	35	55	25

Source: Noise and Excessive Vibration Pollution Control) Regulations, 2009

Table 10: Maximum Permissible Noise Levels for Construction Sites (NEMA)

Facility		Maximum Noise Level Permitted (Leq) in	
		Day	Night
(i)	Health facilities, educational institutions, homes for disabled etc.	60	35
(ii)	Residential	60	35
(iii)	Areas other than those prescribed in (i) and (ii)	75	65

Source: Noise and Excessive Vibration Pollution Control) Regulations, 2009

3.2.5.8 EMCA (Air Quality) Regulations, 2014

The objective of this regulation is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources, including as mobile sources (e.g., motor vehicles). The construction activities will generate emission of fugitive dust caused by a combination of on-site excavation, movement of earth materials, movement of construction vehicles and machinery and exposure of bare soil and soil piles to wind. In addition, air quality will be impacted by exhaust emissions from diesel engines of earth moving equipment and generators, as well the potential burning of solid waste on-site.

The Contractor will be required to observe the limits for Air Quality as provided in Schedule 1 – Ambient Air Quality Tolerance Limits.

The Proponent shall ensure that the Contractor observes the policy and regulatory requirements and implement the mitigation measures proposed in this report.

Table 11: Schedule 1 – Ambient Air Quality Tolerance Limits

	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
1.	Sulphur oxides (SOX);	Annual Average*	80 g/m^3	60 g/m^3	15 g/m^3
		24 hours**	125 g/m^3	80 g/m^3	30 g/m^3
		Annual Average		0.019 ppm/50 g/m^3	
		Month Average			
		24 Hours		0.048ppm /125 g/m^3	
		One Hour			
		Instant Peak		500 g/m^3	
		Instant Peak (10 min)		0.191 ppm	
2.	Oxides of Nitrogen (NOX);	Annual Average*	80 g/m^3	60 g/m^3	15 g/m^3
		24 hours**	150 g/m^3	80 g/m^3	30 g/m^3
		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	
3.	Nitrogen Dioxide	Annual Average	150 g/m^3	0.05 ppm	
		Month Average		0.08 ppm	
		24 Hours	100 g/m^3	0.1 ppm	
		One Hour		0.2 ppm	
		Instant Peak		0.5 ppm	
4.	Suspended Particulate matter (SPM)	Annual Average*	360 g/m^3	140 g/m^3	70 g/m^3
		24 hours**	500 g/m^3	200 g/m^3	100 g/m^3
		mg/Kg			
		Annual Average****		100 g/m^3	
		24 hours***		180 g/m^3	
5.	Respirable Particulate Matter (<10 m) (RPM)	Annual Average*	70 g/m^3	50 g/m^3	50 g/m^3
		24 hours**	150 g/Nm^3	100 g/Nm^3	75 g/Nm^3

	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
6.	$PM_{2.5}$	Annual Average	35 g/m^3		
		24 hours	75 g/m^3		
7.	Lead (Pb)	Annual Average*	1.0 g/Nm^3	0.75 g/Nm^3	0.50 g/m^3
		24 hours**	1.5 g/m^3	1.00 g/m^3	0.75 g/m^3
		Month Average		2.5	
8.	Carbon monoxide (CO)/ carbon dioxide (CO_2)	8 hours**	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3
		1 hour	10.0 mg/m^3	4.0 mg/m^3	2.0 mg/m^3
		mg/Kg			
		24 hours**			
9.	Hydrogen Sulphide	24 hours**	150 g/m^3		
10.	Non-methane hydrocarbons				
		instant Peak	700ppb		
11.	Total VOC	24 hours**	600 g/m^3		
12.	Ozone	1-Hour	200 g/m^3	0.12 ppm	
		8 hour (instant Peak)	120 g/m^3	1.25 ppm	

3.2.6 The Energy Act, 2019

The Energy Act is set to consolidate the laws relating to energy, to provide for National and County Government functions in relation to energy, to provide for the establishment powers and functions of the energy sector entities; promotion of renewable energy; exploration, recovery and commercial utilization of geothermal energy; regulation of midstream and downstream petroleum and coal activities; regulation, production, supply and use of electricity and other energy forms; and for connected purposes. It also governs the management and sustainable use of energy resources and enhancing protection of the environment.

The Act establishes the Energy and Petroleum Regulatory Authority (EPRA) with the mandate to regulate among others the generation, importation, exportation, transmission, distribution, supply and use of electrical energy with the exception of licensing of nuclear facilities.

The Act also establishes the Rural Electrification and Renewable Energy (REREC) that has the following functions among others to develop and update the renewable energy master plan taking into account county specific needs and the principle of equity in the development of renewable energy resources.

The project will be licensed and governed by the act.

3.2.7 The Wildlife Management and Conservation Act 2013

The Wildlife and Conservation Act deals with the conservation and management of wildlife in Kenya. The Act provides that wildlife should be conserved to yield optimum returns in terms of cultural, aesthetic, scientific and economic benefits. The Act requires that full account be taken of the interrelationship between wildlife conservation and land use.

*The proposed Solar PV Power Plant will be located in a disused limestone mining quarry where no habitat restoration has been put in place. The construction activities will make mitigation provisions for the existing biodiversity as informed by the specialist ecological studies that have been carried out. Refer to **Chapter4** and **Appendix 11**.*

3.2.8 The Water Act 2016

The Water Act No. 43 of 2016 was assented to on 20th September 2016. The new Act repealed the water Act 2002. The Act provides for the establishment of the Water Resources Authority (WRA) who have the responsibility to regulate the management and use of water resources. The Act provides for the regulation, management and development of water resources and water and sewerage services in line with the Constitution. The enactment of this law aimed at aligning national water management and water services provision with the requirements of the Constitution of Kenya 2010 particularly on the devolving of water and sanitation services to the county governments.

The Act stipulates that a permit shall be required in all cases of proposed diversion, abstraction, obstruction, storage or use of water, with minor exceptions relating to use for domestic purposes (Section.36). A person shall not throw, convey, cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive matter or thing into or near to any water resource in such manner as to cause, or be likely to cause, pollution of the water resource.

The Contractor shall be expected to make applications for a water abstraction permit for sinking of a borehole subject of public consultation and, where applicable, of environmental impact assessment in accordance with the requirements of the Environmental Management and Coordination Act, 1999 (No. 8 of 1999).

The process of bore drilling entails the following:

- *Contract a licensed Geologist to carry out a hydrogeological survey;*
- *Apply for Water Abstraction Permit from Water Resource Authority (WRA) and attach the hydrogeological report;*
- *Carry out an Environmental Impact Assessment (EIA) Study and submit the report to National Environment Management Authority (NEMA) for licencing;*
- *Contract a licensed Driller to drill and install the borehole.*

3.2.9 The Public Health Act (Chapter 242) of Revised Edition 2012

The Public Health Act (Chapter 242) is an Act of Parliament that provides for securing and maintaining good health of citizens. The Act contains directives that are focused on ensuring protection of human health. There are provisions within the Act that deal with water, air and noise quality as they pertain to human health. An environmental nuisance includes the emission from premises of waste waters, gases and exhaust emissions which could be regarded as injurious to health. The owner and/or occupier of premises responsible for such nuisances are liable to prosecution under the Act.

The construction of the proposed Solar PV Power Plant has potential for pollution risks related to water and air during construction. The contractor will need to ensure that air and water pollution is controlled and does not affect workers and people within the project site area.

3.2.10 Occupational Safety and Health Act 2007

The Act provides for protection of workers during construction and operation phases of the project. This Act will provide some guidance on the mitigation measures for any negative impacts in particular those concerning the workers within the site. Section 17 of the Act further highlights the importance of an employer or in this case Contractor to ensure the health and safety of persons other than his/her employees. As such this Act also ensures the inclusion of community health and safety in this ESIA.

*The project construction, operation and decommissioning activities will have occupational, public health, safety and security issues that have to be mitigated and monitored and this ESHIA proposes a number of mitigation measures as provided under **Chapter 7** and **8**.*

3.2.11 The Environment and Land Court Act, 2011

This is an Act of Parliament to give effect to Article 162(2) (b) of the Constitution to establish a superior court to hear and determine disputes relating to the environment and the use and occupation of land. The Environment and Land Court is one of the Courts contemplated by article 162(2). It is a Superior Court and has the same status as the High Court. The court is established under section 4 of the Environment and Land Court Act No. 19 of 2011. It has jurisdiction to hear any other dispute relating to environment and land.

The jurisdiction of the court is provided under section 13 of the Act. The Court has original and appellate jurisdiction to hear and determine all disputes in accordance with Article162(2) (b) of the Constitution and with the provisions of the Act or any other written law relating to environment and land. The court has powers to deal with disputes relating to land administration and management.

The court is also empowered to hear cases relating to public, private and community land and contracts or other instruments granting any enforceable interests in land. The court also exercises appellate jurisdiction over the decisions of subordinate courts or local tribunals in respect of matters falling within the jurisdiction of the Court. The court further exercises supervisory jurisdiction over the subordinate courts, local tribunals, persons or authorities in accordance with Article 165(6) of the Constitution.

Whereas the project will have an internal Grievance Redress Mechanism (GRM), cases that may not be dealt with conclusively will have the option to seek legal redress through the courts in the event that they are not satisfied with the outcome from GRM.

3.2.12 The National Museums and Heritage Act, 2006

This Act provides for the establishment of the National Museums of Kenya (NMK) to serve as the national repositories for things of scientific, cultural, technological and human interest. The Act provides for the control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya.

*An archaeological and cultural impact assessment has been carried out as part of the ESHIA Study to evaluate the cultural heritage of the project area. The outcome of the assessment is provided in **Chapter 7** & **8** and **Appendix 12**.*

3.2.13 HIV / AIDS Act, 2006

The Act provides for measures of prevention, management and control of HIV and AIDS. It Promotes public health, counselling, support and care for those affected or living with HIV. This Act will ensure that the Contractor makes provision for Voluntary Counselling and Testing (VCT) for the workers. This greatly contribute to management of HIV and AIDS and also bringing down stigmatization.

3.2.14 The National Gender and Equality Act, 2011

National Gender Equality Commission is a constitutional Commission established by an Act of Parliament in August 2011, as a successor commission to the Kenya National Human Rights and Equality Commission pursuant to Article 59 of the Constitution. NGEC derives its mandate from Articles 27, 43, and Chapter Fifteen of the Constitution; and section 8 of NGEC Act (Cap. 15) of 2011, with the objectives of promoting gender equality and freedom from discrimination. Gender mainstreaming in the project will ensure that the concerns of women and men form an integral dimension of the project design, implementation, operation and the monitoring and evaluation ensures that women and men benefit equally, and that inequality is not perpetuated.

The contractor will develop labour management plan. This plan will ensure that gender equality is addressed to the best level possible.

3.2.15 The Employment Act, 2007

The Employment Act, 2007 defines the fundamental rights of employees including the basic conditions of employment of workers. It also regulates employment of children under section 56 which makes it illegal to employ children under the age of 13 years. Children between ages 13 – 16 years can be employed in light work while those between 16 and 18 are considered employable.

The contractor on site will have to employ casual labourers (those who are engaged on need basis and paid daily) probably from the communities where the project is located during construction. The basic conditions of employees should be observed to avoid unnecessary conflicts during the construction works. The Contractor shall pay the entire amount of the wages earned by or payable to the workers. Payment of such wages shall be done at the end of a working day at or near the place of work. The Contractor shall also ensure that all statutory deductions are submitted without delay to appropriate government agencies e.g., Kenya Revenue Authority, NSSF, NHIF, among others.

3.2.16 The Sexual Offences Act, 2006

This Act protects people and employees from any unwanted sexual attention or advances by staff members. This act ensures the safety of women, children and men from any sexual offences which include: rape, defilement, indecent acts.

This law will govern the code of conduct of the Contractor's staff and provide repercussions of any wrong doing. The labour management plan will ensure that sexual rights are protected.

3.2.17 Physical Planning Act (Cap. 286)

This Physical Planning Act, Cap. 286 provides for the preparation and implementation of physical development plans. Section 36 of the Act provides for environmental impact assessments and states that if in connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an environmental impact assessment report'.

The proponent and contractors of the proposed Solar PV Power Plant will need to comply with the requirements of this Act.

The developer will be required to fulfil the following:

- *Submit land ownership documents to the County Government of Machakos;*
- *Prepare and submit a planning report to the County Government of Machakos;*
- *Pay requisite statutory fees;*

The approval process will take approximately one (1) month from the date of submission.

3.2.18 The County Governments Act 2012

The promulgation of the 2010 Constitution brought about devolution and the setting up of County Governments. This Act provides for the roles and functions of the County Government. The County Government approves all development activities within the County, as such will be a major stakeholder for the proposed project.

The Contractor will be expected to carry out implementation of the project in consultation with the County Government of Machakos.

3.2.19 Land Act, 2012.

The Land Act was enacted by Parliament to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land-based resources, and for connected purposes. The Act applies to all land declared as (a) public land under Article 62 of the Constitution; (b) private land under Article 64 of the Constitution; and (c) community land under Article 63 of the Constitution and any other written law relating to community land.

The Land Act guarantees security of tenure for land under (a) freehold; (b) leasehold; (c) such forms of partial interest as may be defined under the Act and other law, including but not limited to easements; and (d) customary land rights, where consistent with the Constitution and guarantees equal recognition and enforcement of land rights arising under all tenure systems and non-discrimination in ownership of, and access to land under all tenure systems. Under the Lands Act 2012, The Wayleaves Act, Cap 292 and The Land Acquisition Act, Cap. 295 have been revoked but Sections 8 and 9 allow for Compulsory Acquisition as an option in acquiring land for public utility.

The land to be occupied by the project is private land belonging to Bamburi Cement PLC. Bamburi will provide the land on sub-lease basis to Momnai Energy for 25 years.

3.2.20 The Climate Change Act, 2016.

The Act establishes the National Climate Change Council whose main function is to advise the National and County Governments on legislative and other measures necessary for mitigating and adapting to the effects of climate change. It provides the legal and institutional framework for the mitigation and adaption to the effects of climate change; to facilitate and enhance response to climate change; to provide for the guidance and measures to achieve low carbon climate resilient development and for connected purposes.

The proposed Solar PV Power Plant is one of the renewable energy technologies that produces clean energy that reduces greenhouse gas emissions and other pollutants to the environment.

3.2.21 The Energy (Solar Photovoltaic Systems) Regulations, 2012

The Energy (Solar Photovoltaic Systems) Regulations, 2019. apply to a Solar PV system manufacturer, importer, vendor, technician, contractor, system owner, a Solar PV system installation and consumer devices. The Regulations provide the following requirements:

- A person shall not design, install, commission, maintain or repair a Solar PV system unless he is licensed by the Authority.
- A person shall not engage in the importation, manufacture, sale or installation of Solar PV systems or Solar PV system components without a valid license issued by the Authority.
- A contractor or technician shall ensure that any Solar PV installation work is carried out and complies with the relevant Kenya Standard and all other relevant technical, legal and regulatory requirements applicable in Kenya.

The developer will be required to fulfil the following:

- *Obtain license for power generation from EPRA;*
- *Obtain license for transmission of power from Kenya Power*
- *Pay requisite statutory fees;*

The approval process takes approximately one (1) month from the date of submission.

The proposed project causes no greenhouse gases to be emitted after installation It alleviate dependence on foreign oil and fossil fuels and reduce the overall power deficit on the national grid.

3.2.22 Environmental Related Permits and Licenses

Table 12 below lists the environment-related permits required in the Project.

Table 12: Environment-Related Permits required in the Project

No.	Relevant activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Period of Acquisition	Duration
Pre-Construction Stage							
1	Construction and operation of Solar Power Plant	Environmental Management and Coordination Act (EMCA) Cap 387, Amended 2015	Need to submit ESHIA report to obtain EIA license	NEMA	Momnai Energy	Upon approval of ESHIA report	Max 90 Days from date of submission of ESHIA Report
2	Construction of Utility Solar Panels at Bamburi Cement Land	Civil Aviation Act, 2013	Need to obtain permission to install overhead TL tower	Kenya Civil Aviation Authority (KCAA)	Momnai Energy	After the study	Indefinite
3	Construction activities	Occupational Safety and Health Act (OSHA), 2007	Need to apply registration of premises	Directorate of Occupational Safety and Health Services (DOSHS)	Contractor	Before commencement of construction	1 – 4 weeks
4	Construction and operation of Solar PV Power Plant	The Energy (Solar Photovoltaic Systems) Regulations, 2012	Need to obtain license to develop and operate the plant	Energy and Petroleum Regulatory Authority (EPRA)	Momnai Energy	Before commencement of construction	
			Need to obtain license to develop and operate the plant	Kenya Power	Momnai Energy	Before commencement of construction	
5	Construction and operation of Solar PV Power Plant	County Governments Act No. 17 of 2012 revised in 2017	Need to obtain clearance of ESHIA report	County Governments of Machakos Counties	Momnai Energy	Upon approval of ESHIA report	Approx. 1 month from submission
6	Setting up of construction Office and/or Social Amenities	Environmental Management and Coordination Act (EMCA) Cap 387, Amended 2015	Need to submit Project report to obtain EIA license	NEMA	Contractor	Before commencement of construction	1 – 1.5 months
7	Water abstraction from water resource (if required)	Water Act, 2016 Water resources management rules,2007	Need to obtain permission to abstract water	Water Resources Authority (WRA)	Contractor	Before commencement of construction	1 – 1.5 months

No.	Relevant activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Period of Acquisition	Duration
8	Drilling of boreholes (if required)	Environmental Management and Coordination Act (EMCA) Cap 387, Amended 2015	Need to submit Project report to obtain EIA license	NEMA	Contractor	Before commencement of construction	1 – 1.5 months
9	Storage, transport and disposal of waste including hazardous waste from site	Environmental Management and Coordination Act (EMCA) Cap 387, Rev 2018	Need to obtain waste license through submission of Waste Management Plan	NEMA	Contractor	Before commencement of construction	1 – 1.5 months
Construction Stage							
1	Blasting of construction site bedrocks (if required)	License to manufacture explosives pursuant to the explosives (Blasting explosive) (amendment) rules of 1969 section 11 of the Explosives Act, CAP 115	Appointment of a blaster	Mines and Geology Department in Ministry of Environment and Forestry	Contractor	Before blasting works	Max 1 month
2	Blasting the bedrocks by use of Ammonium nitrate-fuel oil explosives (if required)	License to manufacture explosives pursuant to section 18 of the Explosives Act, CAP 115	Need to obtain permit to blast	Mines and Geology Department in Ministry of Environment and Forestry	Contractor	Mines and Geology Department in Ministry of Environment and Forestry	Max 3weeks
3	Emission of excessive noise/vibration (if required)	Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009	Need to obtain permit to emit excess noise/vibration	NEMA	Contractor	Before excessive noise/vibration works	2 days

No.	Relevant activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Period of Acquisition	Duration
4	Registration of construction site a workplace	Registration of campsite as a work place pursuant to OSHA No. 15 of 2007	Need to obtain workplace registration certificate for the contractor's campsite	DOSHS	Contractor	Before commencement of construction	2 weeks
5	Employment of a safety officer to enhance compliance to OSHA,2007	Notice of appointment of Safety Officer / Supervisor pursuant to Building Operations and Works of Engineering Construction Rules, 1984	Need to appoint a safety officer to oversee and enhance safety issues on site	DOSHS	Contractor	Before commencement of construction	1 week
5	First aid on site	Obtain First Aid Leaflets from DOSHS pursuant to First Aid Rules, 1977	Need to have a first aider and adhere to rules	DOSHS	Contractor	Before commencement of the work	1 week
6	Compensation issues on site	Registration for Workmen's Compensation pursuant to Workers Injury Benefits Act No. 13 of 2007	Need to insure the workers in case of any injuries on site	DOSHS	Contractor	Before commencement of the work	1 week
Operational phase							
7	Registration of construction site a workplace	Registration of campsite as a work place pursuant to OSHA No. 15 of 2007	Need to obtain workplace registration certificate for the contractor's campsite	DOSHS	Contractor	Before commencement of construction	2 weeks

3.3 International Guidelines

3.3.1 IFC Performance Standards on Environmental and Social Sustainability

The IFC Performance Standards are intended to provide guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations in relation to project-level activities. IFC requires its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced.

IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation in order to achieve its overall development objectives.

There are eight IFC Performance Standards that the proposed Solar PV Power Plant at Athi River in Machakos County is supposed to meet throughout the life of this investment.

Table 13: IFC PS on Environmental and Social Sustainability

PS	Performance Standard	Remarks	Triggered
PS1	***Assessment and Management of Environmental and Social Risks and Impacts.*** • Identify project E&S risks and impacts • Adopt mitigation hierarchy (anticipate/avoid, minimize, compensate/offset) • Improve performance through an Environmental and Social Management System (ESMS) • Engagement with Affected Communities, other stakeholders	Applies to all projects that have environmental and social impacts There are community members/ stakeholders that needed to be engaged This ESHIA process will culminate in the implementation of the EMMP by the Proponent.	Yes
PS 2	***Labour and Working Conditions*** • To promote the fair treatment, non-discrimination, and equal opportunity of workers. • To establish, maintain, and improve the worker-management relationship. • To promote compliance with national employment and labour laws. • To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. • To promote safe and healthy working conditions, and the health of workers. • To avoid the use of forced labour.	Applies to workers directly engaged by the client (direct workers), workers engaged through third parties contracted workers), as well as workers engaged by the client's primary suppliers (supply chain workers). Project area community will be employed in the project as unskilled or skilled labourers. There is potential for migrant workers to move into project area looking for job opportunities	Yes
PS 3	***Resource Efficiency and Pollution Prevention*** • Avoid, minimize, and reduce project-related pollution • More sustainable use of resources, including energy and water Reduced project-related Greenhouse Gas (GHG) emissions	There are project activities like maintenance of vehicles and machines, fugitive dust and exhaust emissions that have the potential to cause pollution. Project will also require water that needs to be extracted and used sustainably.	Yes

PS	Performance Standard	Remarks	Triggered
PS 4	***Community Health, Safety, and Security*** • To anticipate and avoid adverse impacts on the health and safety of the Affected Community • To safeguard personnel and property in accordance with relevant human rights principles	The project area community will either be directly or indirectly affected by the project	Yes
PS 5	***Land Acquisition and Involuntary Resettlement*** • Avoid, minimize adverse social and economic impacts from land acquisition or restrictions on land use • Improve or restore livelihoods and standards of living • Improve living conditions among displaced persons	Project being implemented on private land belonging to project proponent and there is no settlement on the land	No
PS 6	***Biodiversity Conservation and Sustainable Management of Living Natural Resources*** • Protection and conservation of biodiversity • Maintenance of benefits from ecosystem services • Promotion of sustainable management of living natural resources	Project is located in a modified natural habitat with flora and fauna	Yes
PS 7	***Indigenous Peoples*** • Ensure full respect for IPs (human rights, dignity, aspirations, livelihoods, culture, knowledge, practices) • Avoid, minimize adverse impacts • Sustainable and culturally appropriate development benefits and opportunities • Free, Prior and Informed Consent (FPIC) in certain circumstances	There are no indigenous peoples in the project as described in PS 5	No
PS 8	***Cultural Heritage*** • Protection and preservation of cultural heritage • Promotion of equitable sharing of cultural heritage benefits	*Site evaluation has been done and a no objection to proceed given. However, a "Chance Find Procedure" has been provided should the Contractor encounter anything of cultural importance.*	No

3.3.2 World Bank Group Environmental, Health and Safety (EHS) Guidelines

The Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These General EHS Guidelines are used in addition to the local guidelines in order to provide mitigation measures for the various environmental and social impacts that will be identified in this report. The main EHS guidelines that will be used alongside local policies include:

- Environmental Guidelines
- Occupational Health and Safety Guidelines
- Community Health and Safety Guidelines
- Construction and Decommissioning Guidelines

The project will be designed to operate in compliance with the relevant World Bank EHS Guidelines.

3.3.3 EIB Environmental and Social Standards

The EIB is a public institution driven by the policy objectives of the European Union and their principles of sustainable development, public participation, and accountability. It seeks to promote sustainable and inclusive growth while protecting the natural and social environment in a holistic manner, thereby ensuring that requirements relating to the protection of the environment and human well-being are integrated in the definition, preparation and implementation of all operations. To this end EIB has developed 10 Environmental and Social Standards out of which the 8 applicable standards are highlighted below.

3.3.3.1 Assessment and Management of Environmental and Social Impacts and Risks

This standard underscore the importance of managing environmental and social impacts and risks throughout the life of a project through the application of the precautionary principle. The standard's requirements allow for the development of an effective environmental and social management and reporting system that is objective and encourages continual improvements and developments. The standard includes requirements for stakeholder engagement and disclosure throughout the life of the project.

An Environmental, Social and Health Impact Assessment (ESHIA) Studies to identify the potential risks and impacts and develop appropriate mitigation measures and a monitoring plan has been commissioned.

3.3.3.2 Pollution Prevention and Abatement

The objective of this standard is to avoid and minimise pollution. It outlines a project-level approach to resource efficiency and pollution prevention and control in line with best available techniques and internationally disseminated practices.

*The commissioned ESHIA Study has identified potential pollution sources and provided mitigation measures. Refer to **Chapter 7** for details.*

3.3.3.3 Biodiversity and Ecosystems

This standard outlines the approach and measures the promoter has to take to protect and conserve all levels of biodiversity. The standard applies to all habitats (marine and terrestrial) whether or not previously disturbed or legally protected. It focuses on major threats and supports the sustainable use of renewable natural resources and the equitable sharing of benefits from the project's use of natural resources.

*A dedicated ecological study has been carried out to identify the flora and fauna present in the project area so that appropriate mitigation measures can be provided. Refer **Appendix 11** of this report.*

3.3.3.4 Climate Related Standards

EIB financing as a whole is aligned with EU climate policies, which should be taken into account at all stages of the project cycle, in particular regarding the assessment of the economic cost of greenhouse gas emissions and the climate vulnerability context.
Specifically, project promoters must ensure that all projects comply with appropriate national and, where applicable, EU legal requirements, including multilateral agreements, related to climate change policy.

The proposed project is a renewable energy source that will provide clean energy without Greenhouse Gases emission hence complies with both the national and EIB requirements.

3.3.3.5 Cultural Heritage

Through its projects, the EIB recognises the central role of cultural heritage within individual and collective identity, in supporting sustainable development and in promoting cultural diversity. Consistent with the applicable international conventions and declarations, this standard aims at the identification, management and protection of tangible and intangible cultural heritage that may be affected by project activities. It emphasises the need for the implementation of a "chance-find procedure", which outlines the actions to be taken if previously unknown cultural heritage is encountered.

An archaeological and cultural impact assessment has been carried out as part of the ESHIA Study to evaluate the cultural heritage of the project area. The outcome of the assessment is provided in ***Chapter 7*** *and* ***Appendix 12****.*

3.3.3.6 Labour Standards

Good labour practices and the use of appropriate codes of conduct are important to ensure the fair treatment, non-discrimination and equality of opportunity of workers. This standard aims at ensuring that project implementation is carried out in compliance with the core labour standards of the International Labour Organisation and with national labour and employment laws. The standard also requires the establishment, maintenance and improvement of worker-management relationships.

The Contractor will prepare a labour management plan which will be expected to comply with these requirements.

3.3.3.7 Occupational and Public Health, Safety and Security

The EIB expects promoters to protect and secure public and occupational health, safety and security and promote the dignity of the affected community in relation to project-related activities, with particular attention to vulnerable groups. The standard also requires promoters to adhere to the international norms and relevant human rights principles when using security services.

The project construction, operation and decommissioning activities will have occupational, public health, safety and security issues that have to be mitigated and monitored and this ESHIA proposes a number of mitigation measures as provided under ***Chapter 7****.*

3.3.3.8 Stakeholder Engagement

This standard requires promoters to uphold an open, transparent and accountable dialogue with all project affected communities and relevant stakeholders in an effective and appropriate manner. The value of public participation in the decision-making process is stressed throughout the preparation, implementation and monitoring phases of a project. The right to access to remedy, including through grievance resolution, is actively required.

Consultations and engagement with stakeholders and project area community is being carried during this ESHIA Study. A Stakeholder Engagement Plan and Grievance Redress Mechanism will be developed as part of the study.

Table 14: EIB Environmental and Social Standards

Standards	Standard	Remarks	Trigger
1	Environmental and Social Impacts and Risks	This Standard applies to all projects likely to have significant environmental, climate and/or social impacts and risks. *ESHIA Study has been carried out and potential impacts have been identified for mitigation*	Yes
2	Stakeholder Engagement	This Standard applies to all projects likely to have significant environmental, climate and/or social impacts and risks. *Stakeholders have been engaged and will be meaningfully consulted and engaged throughout the project life cycle*	Yes
3	Resource Efficiency and Pollution Prevention	This Standard applies to all projects likely to have significant environmental, climate and/or social impacts and risks. *Project will use machines and vehicles that can impact soil and other resources*	Yes
4	Biodiversity and Ecosystems	This Standard applies to all projects likely to have significant environmental, climate and/or social impacts and risks . *The site has flora and fauna hence there will be habitat loss and fragmentation of natural habitat*	Yes
5	Climate Change	This Standard further recognises the role of finance in supporting low-carbon and climate-resilient development, i.e. in (i) addressing climate change by reducing greenhouse gas (GHG) emissions; "Do No Significant Harm" principle T*he Solar PV Power Plant is endeavouring to reduce GHG*	No
6	Involuntary Resettlement	This Standard also applies to the displacement of persons without formal, traditional or recognisable usage rights, who are occupying or utilising land prior to the cut-off-date8 *There are no persons being displaced*	No
7	Vulnerable Groups, Indigenous Peoples and Gender	Applies whenever vulnerable, marginalised or discriminated-against persons and/or groups are affected by the project *The project area has gender issues*	Yes - Gender
8	Labour Rights	This Standard applies to project workers including full-time, part-time, temporary, seasonal and migrant workers *The project will employ people and there is potential for labour influx*	Yes
9	Health, Safety and Security	This Standard applies to all projects that are likely to affect, directly or indirectly, occupational and/or public health, safety and security and the specific requirements that need to be addressed *There construction activities that will pose safety risks hence require assessment*	Yes
10	Cultural Heritage	This Standard also applies to projects under implementation that are likely to have a significant impact on cultural heritage but were not previously identified as such and for which chance find procedures shall be applied. *Site evaluation has been done and a no objection to proceed given. However, a "Chance Find Procedure"*	No

Standards	Standard	Remarks	Trigger
		has been provided should the Contractor encounter anything of cultural importance.	

3.4 International Conventions

Kenya is signatory to several international conventions and treaties that would need to be adhered to when implementing this project. These conventions are geared towards environmental protection and conservation.

3.4.1.1 International Labour Organization (ILO) Conventions

The Government of Kenya has ratified 50 ILO Conventions and those that are relevant to this study include:

- Safety and Health in Construction Recommendation, 1988 (No. 167)
- Minimum Age Convention, 1973 (No. 138) Minimum age specified: 16 years
- Migrant Workers (Supplementary Provisions) Convention, 1975 (No. 143)
- Equality of Treatment Convention (Social Security) Convention, 1962 (No 118)
- Workmen's Compensation (Accidents) Convention, 1925 (No 17)
- Equality of Treatment (Accident Compensation) Convention, 1925 (No. 19)
- Abolition of Forced Labour Convention, 1957 (No. 105),
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187);
- Night Work Convention, 1990 (No. 171);
- Asbestos Convention, 1986 (No. 162)
- Occupational Safety and Health Convention, 1981 (No. 155)
- Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)
- Medical Care and Sickness Benefits Convention, 1969 (No. 130);
- Night Work (Women) Convention (Revised), 1948 (No. 89)
- Minimum Wage Fixing Convention, 1970 (No. 131)
- Worst Forms of Child Labour Convention, 1999 (No. 182)

3.4.1.2 Other Conventions

- Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention) 2001;
- United Nations (UN) Convention on Biological Diversity 1994 UN Framework Convention on Climate Change, 1992;
- Kyoto Protocol to the United Nations Framework Convention on Climate Change
- Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (Basel Convention) 1989;
- Montreal Protocol on Substances that Deplete the Ozone Layer Vienna Convention on the Ozone Layer 1985;
- Convention Concerning the Protection of the World Cultural and National Heritage (World Heritage Convention), Paris, 1975;
- Convention on the Conservation of Migratory Species of Wildlife Animals, 1979
- Convention on Biodiversity (CBD)
- Convention on the Conservation of Migratory Species
- United Nations Framework Convention on Climate Change (UNFCCC): Paris Agreement
- United Nations Convention to Combat Desertification (UNCCD)
- The World Heritage Convention
- New Partnership for Africa Development (NEPAD)

3.5 Institutional Framework

There are various national institutions that are important in energy matters related to environmental management in Kenya.

These are described in **Table 15** overleaf.

Table 15: Roles of Organizations involved in the Project

No.	Institution	Role/Function
1	Ministry of Energy	The Ministry of Energy is responsible for formulation and articulation of energy policies through which it provides an enabling environment for all stakeholders. The task of the ministry includes national energy planning, training of manpower and mobilization of financial resources
2	Energy and Petroleum Regulatory Authority (EPRA) - Replaces Energy Regulatory Commission (ERC) from 2019	EPRA is responsible for the economic and technical regulation of the electric power, renewable and petroleum sub sectors. It has the mandate of: • Regulating among others: ✓ Generation, importation, exportation, transmission, distribution, supply and use of electrical energy with the exception of licensing of nuclear facilities; ✓ Production, conversion, distribution, supply, marketing and use of renewable energy; • Co-ordinate the development and implementation of a national energy efficiency and conservation action plan, in consultation with relevant statutory authorities and other stakeholders; • Issue, renew, modify, suspend or revoke licenses and permits for all undertakings and activities in the energy sector; • Formulate, set, enforce and review environmental, health, safety and quality standards for the energy sector in coordination with other statutory authorities;
3	Rural Electrification and Renewable Energy Corporation (REREC) Replaces Rural Electrification Authority (REA) from 2019	Rural Electrification and Renewable Energy (REREC) has the following functions among others: • Develop and update the renewable energy master plan taking into account county specific needs and the principle of equity in the development of renewable energy resources; • Develop, promote and manage in collaboration with other agencies, the use of renewable energy and technologies, including solar energy among others; • Provide an enabling framework for the efficient and sustainable production, conversion, distribution, marketing and utilization of biomass, solar, wind, small hydros, municipal waste; • Promote, in collaboration with other agencies, the development of appropriate local capacity for the manufacture, installation, maintenance and operation of renewable technologies such as biodigesters, solar systems, turbines and other renewable energy technologies; • Promote international co-operation programmes focusing on renewable energy sources;
4	KENGEN	A State Corporation with GoK shareholding of 70% and private shareholding of 30% as at June 2014. It is mandated to generate electric power, currently producing the bulk of electricity consumed in the country. The company currently utilises various sources including hydro, geothermal, thermal and wind to generate electricity.

No.	Institution	Role/Function
5	Kenya Power	The Kenya Power and Lighting Company PLC (Kenya Power) owns and operates most of the electricity transmission and distribution system in the country and sells electricity to consumers. Kenya Power is a State Corporation with Government of Kenya (GoK) shareholding of 50.1% and private shareholding of 49.9%. • It purchases electrical energy in bulk from KenGen and other power producers and carries out transmission, distribution, supply and retail of electric power. • It also builds and maintains the power distribution and transmission network and retail electricity to its customers.
6	Energy Tribunal	This quasi-judicial body was established under section 108 of the Energy Act, 2006. It came into operation in July 2007 to primarily hear appeals against the decisions of ERC. It also has jurisdiction to hear and determine all matters referred to it relating to the energy sector
7	The County and Sub-County Environment Committees	The Environment Committee swill: • Approve applications for Contractor's site camps • Provide permits for quarries and borrow pit sites • Audit the Contractors camps and construction sites for safeguards compliance
8	The National Environment Management Authority (NEMA	NEMA will: • Approve the ESHIA Report • Issue EIA License for project implementation • Carry out independent Audit to determine compliance with ESMP
9	Kenya Wildlife Service (KWS)	KWS will Guide and monitor project construction throughout the project cycle since the project area though in a private land, wildlife species are present
10	Water Resources Authority (WRA)	WRA • Provides necessary water abstraction permits for boreholes and surface water sources (rivers, streams etc) • Monitors water use in the region and provides guidance water use
11	The National Museums of Kenya (NMK)	NMK will: • Carry out recovery of any physical, cultural or archaeological artefacts encountered during construction • Guide the Contractor's team on the protection of physical cultural resources
12	County Governments of Machakos	County Governments will: • Provide approval for the project • Provide Approval for camp sites, borrow pit and quarry sites.

No.	Institution	Role/Function
		• Provide support
13	County Government - Department of Education, Gender, Youth, and Social Services	County Department will: • Provide support to any group at higher risk of being subjected to discriminatory practices, violence, natural or environmental disasters, or economic hardship than other groups within the state • Provide support to any group or sector of society (such as women, children or the elderly)
14	The Ministry of Public Service, Youth and Gender Affairs	To coordinate gender mainstreaming in national development planning and promote equitable political and socio-economic development for women, men, girls and boys.
15	National Construction Authority (NCA)	NCA • Registers contractors carrying out construction activities in Kenya • Inspects constructions for compliance
16	Kenya National Commission on Human Rights (KNCHR),	KNCHR: • Investigates and provides redress for human rights violations • Carries out research and monitor the compliance of human rights norms and standards, • Conducts human rights education,
17	Commission on Administrative Justice (CAJ) also known as the "Office of the Ombudsman"	CAJ • Investigates any conduct in state affairs or any act or omission in public administration in any sphere of Government • investigate complaints of abuse of power, unfair treatment, manifest injustice or unlawful, oppressive, unfair, or unresponsive official conduct.
18	National Gender and Equality Commission	The Commission: • Ensures that there is gender equality and equity throughout the implementation of the project. • Representatives will monitor and evaluate gender quality and equity with regards to job provision and harassment cases on site to ensure compliance with the law.
19	Directorate of Occupational Safety and Health Services (DOSHS)	DOSHS: • Provides OSH permits for workplaces of the project including campsites and quarries • Conducts inspections to ensure conformance to OSHA
20	Contractor	**Contractor** • Will engage the following dedicated full-time safeguards staff ✓ Environmental Safeguards Specialist ✓ Social Safeguards Specialist

No.	Institution	Role/Function
		✓ Registered Occupational Health and Safety (OHS) Expert • Will Prepare the CESMPs and other plans before construction begins • Will operationalize and implement the CESMPs • Will have full time Environmental, Health and Safety and Social Specialists • Will carry out day to day management of E H& S risks evaluation • Will report on incidents and accidents to the Project Supervisor and regulators

4 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

This section describes the major elements of the project area's environment, encompassing the physical, biological and social environment as well as the condition of the proposed project site. The information presented in this section is based on observation of the project area by the consultants as well as information from secondary literature.

4.1 Standards Triggered by the Project

During the evaluation of the project for impacts, IFC Performance Standards (PS) PS1, PS2, PS3, PS4 and PS6 were triggered as shown in **Table 9**. Under the EIB Environmental and Social Standards, the project triggered Standards 1, 2, 3, 4, 7, 8 and 9 (**Table 10**).

The ESHIA Study has been carried taking into cognisance of the above standards triggered by the project.

4.2 The Physical Environment

The proposed project area is found in Athi River town, the headquarters of Mavoko Sub County. Mavoko Sub County covers an area of 693 Km^2 extending from bordering Nairobi County to the West and North, Machakos Sub County on the East and Kajiado County to the South. Athi River Town is at the junction of the Nairobi–Mombasa and Nairobi–Namanga Highways. The town also sits at the confluence of the Mbagathi and Kitengela Rivers which join to form Athi River, the second largest drainage system in the Country and from which it derives its name.

The project site will be located on Plot Nos. 18696/14 - 26 within Bamburi Cement Grinding plant premises about 1km off Nairobi-Mombasa Highway and Nairobi-Namanga Road, and is accessible via Old Mombasa Road which connects to Nairobi-Namanga Road at the Shalom Community Hospital Junction. The site is located on the GPS coordinates is 1°25'29.4"S 36°56'59.5"E and at an altitude of about 1544 metres above sea level.

4.2.1 Climate

(a) Rainfall

The County receives bimodal rainfall with short rains in October and December while the long rains from March to May. The rainfall range is between 500mm and 1250mm, which is unevenly distributed and unreliable. Athi River, just like many parts in Machakos County experiences a bimodal rainfall pattern. The short rains fall between October and December while the long rains fall between mid-March and May. Annual rainfall is influenced by altitude with a mean annual rainfall of approx. 673 mm. Refer to **Table 16** for average rainfall distribution in Athi River area.

Table 16: Average Monthly Rainfall in Athi River, Machakos County

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	28	33	56	125	83	69	32	33	31	61	67	58

(b) Temperature

The hottest months are January-March (27°C). The lowest temperature s is recorded in the months of July-Temperature (12.7°C).

Table 17 provides the average maximum and minimum temperatures

Table 17: Average Monthly Max and Min Temperature

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Temp (ºC)	25.7	27	26.8	24.7	22.9	22.4	22.6	23	24.6	25.3	24	24.1
Min Temp (ºC)	13.4	14.3	15.3	15.6	14.2	13.2	12.7	13.8	14.2	15.3	14.9	13.9

(c) Surface Wind

The strongest winds occur during the dry season just prior to the "Long Rains" when speeds of 11.8km/h are common from mid-morning to early afternoon; at other times of the year winds speeds are usually low and in June the wind speed is lowest at approx. 6.1km/h. During the night the wind is usually light. **Table 18** provides the monthly average wind speeds.

Table 18: Average Monthly Surface Wind (Km/Hour)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind Speed (Km/Hr)	11.1	11.8	11	8.6	7	6.1	6.9	8.1	9.1	10.9	10.8	11.1

(d) Relative Humidity

The humidity in Athi River area varies between 65% and 84%. The humidity is lowest in the month of February and peaks in the month of May. Refer to **Table 19** for average monthly humidity.

Table 19: Average Monthly Relative Humidity (%)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Relative Humidity (%)	69	65	67	80	84	80	74	70	67	68	78	78

Generally, the climate in Athi River is mostly sunny and hence conducive for this project.

4.2.2 Topography

The elevation of the project area is approx..1,500m above sea level. The land surface is uneven due to past excavations and soil stockpiles.. Currently, various hazardous materials are being deposited at the middle section of the site by members of the public.

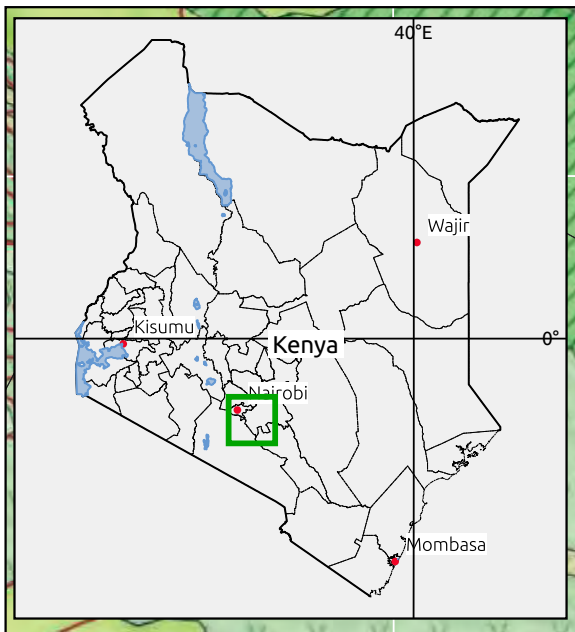
4.2.3 Geology and Soil

4.2.3.1 Geology

The geology of the area is characterized by a succession of lava and pyroclastics overlying a foundation of pre-Cambrian schists and gneisses of Mozambique belt. This region forms the eastern border zone of the rift valley which was associated with volcanicity. The proposed site is covered by black cotton soils, Athi tuffs and lake beds and Kapiti Phonolites that are underlain by gneisses and schists of Pre-Cambrian age. The black cotton soils overly thin layers of sandy sediments and tuffs of Athi tuffs and lake beds which resulted from consolidation of fragmented volcanic material deposits. The volcanic rocks in this area are not particularly permeable to contribute to ground water, but fractures zones and weathered layers form zones for groundwater. The groundwater may be saline or hard with concentration of chloride, sulphate and fluoride (Chimba,2009).
These rocky basements are suitable for providing strong foundations for construction.

36°48′E 36°54′E

1°12′S 1°18′S 1°24′S



Legend

Sediments
- Alluvial fan
- Kedong Lake Sediments
- Lacustrine Sediments

Volcanics

Holocene
- Longonot lower trachyte
- Longonot ashes

Pleistocene: Upper
- Kedong Valley Tuff

Pleistocene: Ionian
- Suswa shield trachytes
- Barajai Trachyte,
- Mt Margaret

Pleistocene: Calabrian
- Tepesi Basalt

Pleistocene: Gelasian
- Limuru Pantellerite
- Limuru Trachyte
- Tigoni Trachyte
- Karura Trachyte
- Kabete Trachyte
- Ngong Hills

Pliocene
- Kinangop Tuff soils
- Kinangop Tuff
- U. Kerichwa Tuffs
- L. Kerichwa Tuff
- Narok Agglomerate
- Nairobi Trachyte
- Kiambu Trachyte
- Nairobi Phonolite

Miocene
- Esayeti
- Kandizi Phonolite
- Athi Tuffs
- Mbagathi Trachyte
- Kapiti Phonolite

Metamorphics
- Undifferentiated

- faults-large
- faults-small
- rivers
- 200m-contour
- City
- Town
- Village
- Road-major
- Road-minor
- Road-track
- rail

Athi River Solar PV Proiect Site

Environmental, Social and Health Impact Assessment for Proposed Momnai Solar Farm Power Project at Athi River

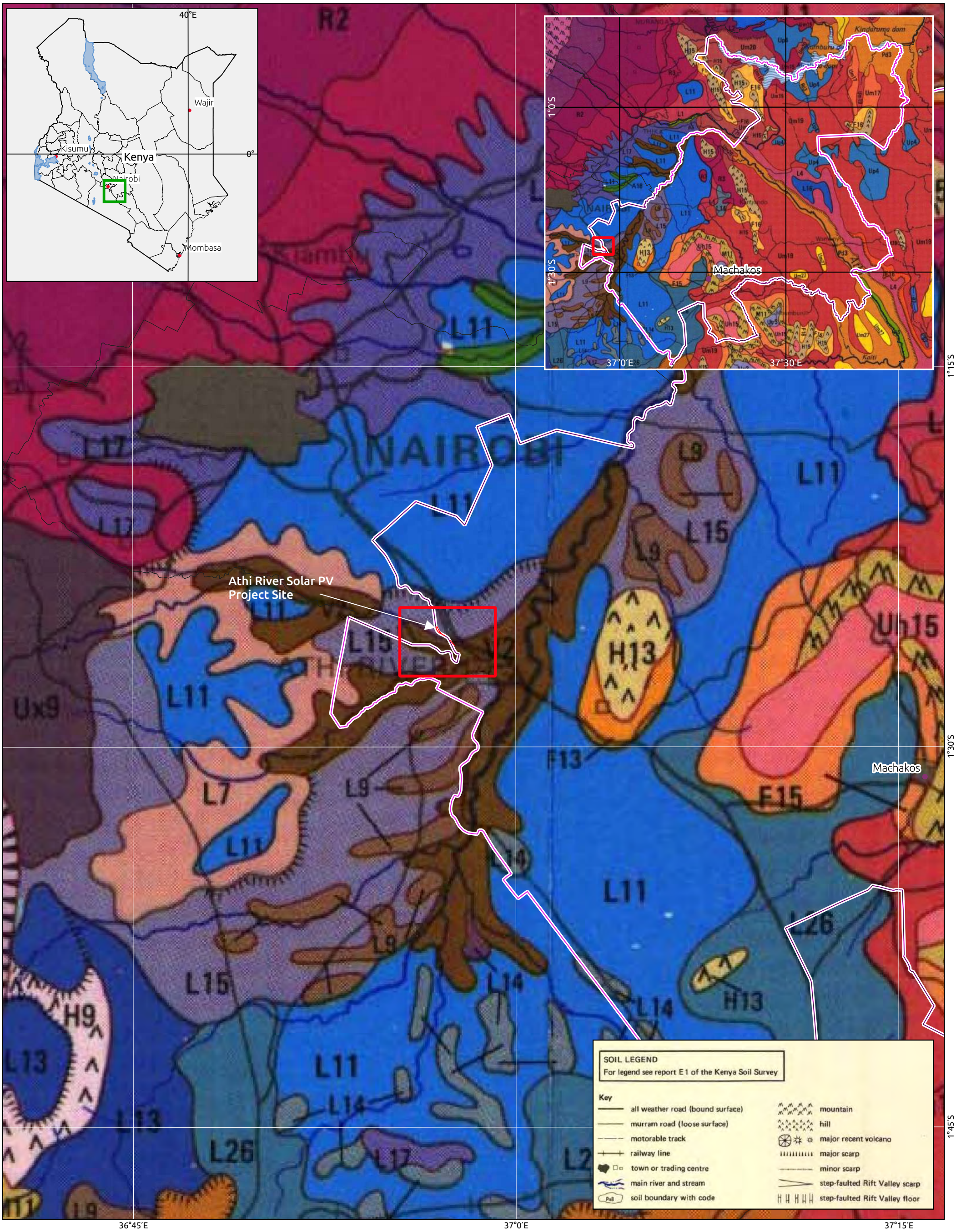
Map Sheet 5 : Proposed Athi River Power Plant - Geological Map

EPSG:4326

2.5 0 2.5 5 7.5 km

Grid North

LEGEND
- Machakos County
- Project Area



Environmental, Social and Health Impact Assessment for Proposed Momnai Solar Farm Power Project at Athi River

Map Sheet 6 : Proposed Athi River Power Plant - Soils

LEGEND
- Machakos County
- Project Site

5 0 5 10 15 km

EPSG:4326

Grid North

4.2.3.2 Baseline Data for Soil

The soils on site are black cotton, commonly associated with the Athi Kapiti Plains and are prone to waterlogging during rainy seasons. The soils covering the area have greatly been influenced by the underlying basement rock system. Most parts of the area are covered by thin black cotton soils which is a great impediment to urban development and construction in particular.

In order to have baseline data for future monitoring purposes, soil sample was collected for the analysis of Total Petroleum Hydrocarbons (TPH) and Heavy Metals [Lead (Pb), Nickel (Ni), Cadmium(Cd), Mercury (Hg), Chromium (Cr) and Lithium (Li)].

a) Methodology

The sampling, handling, storing and transporting of the soil samples to the laboratory was done by NEMA Approved Laboratory according to ISO 5667:2012 Part 3 - Guidance on the Preservation and Handling of Samples. The samples were collected from beneath the ground at a depth of 0.0-1.5 meters directly using a manual soil sampling augur.

Interpretation of the results:

All the parameters analyzed were found to be within the limits contained in the National Environment Management Authority (NEMA) Environmental Inspection and Monitoring Manual (developed for petroleum industry) Document Revision Draft 2.0 Issued October 2020. Refer to **Tables 20 and 21** below.

Table 20: Total Petroleum Hydrocarbons

Tests	Results	Units	Test Limits	Method	Ref. Std
(- C5- C6) Pentanes	16.22	µg/kg	*	AQTP	NEMA
(- C>6 - C8) Hexanes	21.41	µg/kg	*	AQTP	NEMA
(- C>8 - C10) Heptanes	30.44	µg/kg	*	AQTP	NEMA
(- C>10 - C12) Octanes	46.31	µg/kg	*	AQTP	NEMA
(- C>12 - C16) Nonanes	77.23	µg/kg	*	AQTP	NEMA
(- C>16 - C35) Decanes	89.18	µg/kg	*	AQTP	NEMA

Table 21: Heavy Metals

Tests	Results	Units	Test Limits	Method	Ref. Std
Lead (Pb)	16.41	µg/kg	375	AQTP 150	NEMA
Nickel (Ni)	< 0.01	µg/kg	150	AQTP 150	NEMA
Cadmium (Cd)	< 0.01	µg/kg	1.4	AQTP 150	NEMA
Mercury (Hg)	<0.01	µg/kg	6.6	AQTP 150	NEMA
Chromium (Cr)	<0.01	µg/kg	64	AQTP 150	NEMA
Lithium (Li)	<0.01	µg/kg	N/A	AQTP 150	NEMA

During the construction phase, soil contamination may result from leaks and spills of oil, lubricants, or fuel from heavy equipment, improper handling of chemical/fuel storage and wastewater. Such spills could have an impact on soil and water quality, but are expected to be localised in nature. However, the site will apply proper storage and handling for fuel, oil and lubricants.

4.2.4 Hydrology, Hydrogeology and Water Supply

4.2.4.1 Hydrology and Hydrogeology

According to the Machakos County Integrated Development Plan II (2018-2022), The county is water scarce county with its water situation levels below the national natural endowment of 647m^3 per capita per year. Its arid and semi-arid areas are critically limited in water endowment. This serious water stress adversely affects food production and often disrupts economic development. Water resources in the County are mainly boreholes, seasonal rivers, dams and springs. The project area (Athi River Town) sits at the confluence of the Mbagathi and Kitengela Rivers which join to form Athi River, the second largest drainage system in the Country and from which it derives its name.

4.2.4.2 Water Supply

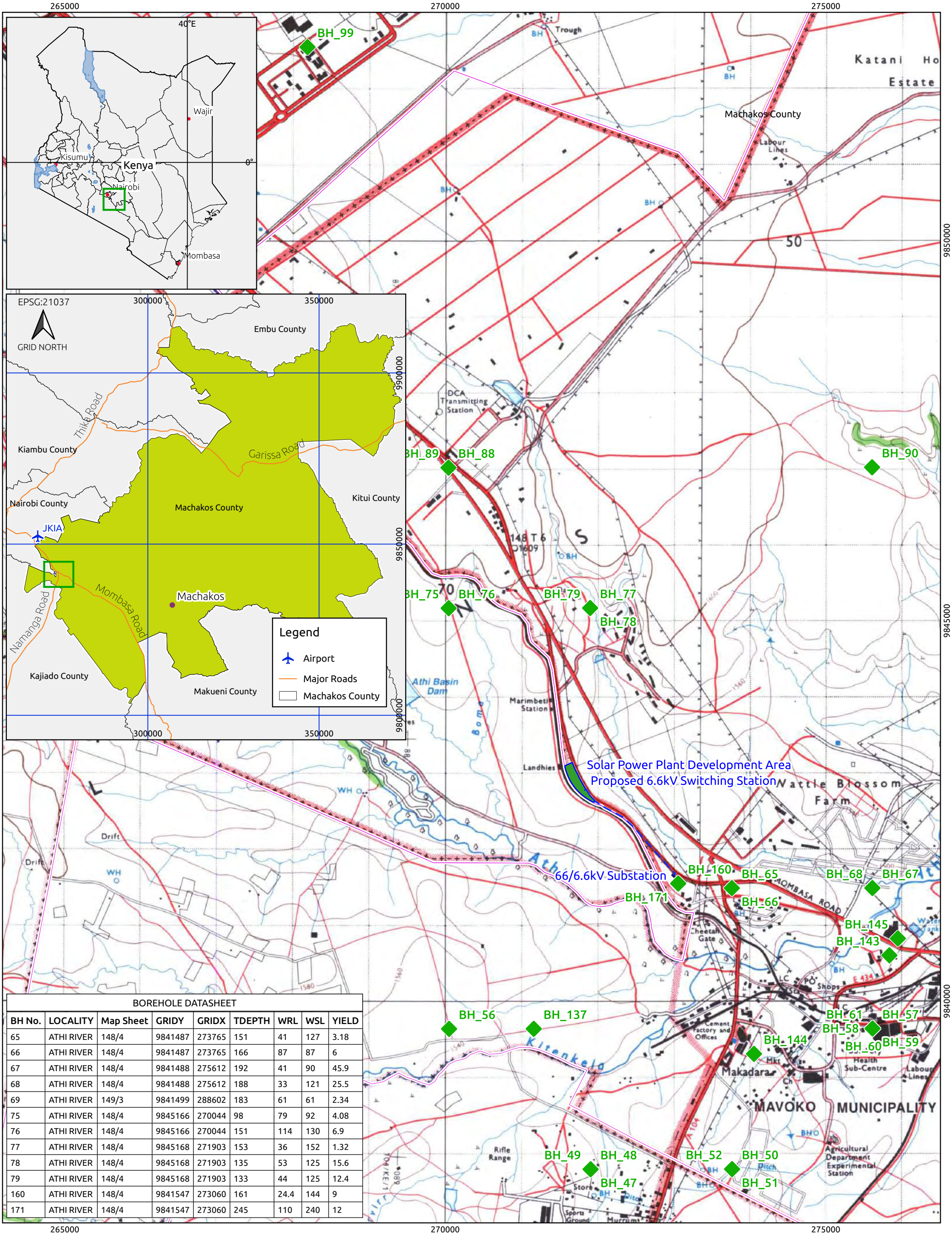
The project area is served by Mavoko Water and Sewerage Company. Due to the inadequacy of piped water supply to the area, majority of the industries operating in the area have sunk boreholes as alternative source of water for their operations. **Table 22** below, provides selected key parameters for some of the existing boreholes within the project area. Most of the boreholes are tapping water bearing layers (aquifers) between 120 – 160m.

Table 22: Data of Selected Boreholes within the Project Area

#	Locality	Map No	GridX	GridY	TDepth	WSL	WRL	Yield
BH65	Athi River	148/4	273765	9841487	151	127	41	3.18
BH66	Athi River	148/4	273765	9841487	166	87	87	6.00
BH67	Athi River	148/4	275612	9841488	192	90	41	45.90
BH68	Athi River	148/4	275612	9841488	188	121	33	25.50
BH76	Athi River	148/4	270044	9845166	151	130	114	6.90
BH77	Athi River	148/4	271903	9845168	153	152	36	1.32
BH78	Athi River	148/4	271903	9845168	135	125	53	15.60
BH79	Athi River	148/4	271903	9845168	133	125	44	12.40
BH160	Athi River	148/4	273060	9841547	161	144	24.4	9.00
BH171	Athi River	148/4	273060	9841547	245	240	110	12.00

4.2.4.3 Water Quality

Ground water sources (boreholes and wells) supplement surface water sources. Most of these water sources are under threat of pollution from agricultural chemicals, urban and industrial wastes especially the Athi River, which is under threat of pollution from the Nairobi city and adjacent towns. The water resources are also under pressure for use in agricultural irrigation, domestic, industrial and use for hydroelectric power generation. A study on the Groundwater quality index of Upper Athi River Basin in Kenya revealed that the Water Quality Index (WQI) of the groundwater ranged from 115 to 778 with mean value of 234, which is twice the upper limit (100) for potable water. The high WQI values could largely be attributed to high concentrations of manganese, iron, nitrate, turbidity and chloride mainly observed in shallow wells and boreholes (Ashun & Bansah, 2017).



BOREHOLE DATASHEET

BH No.	LOCALITY	Map Sheet	GRIDY	GRIDX	TDEPTH	WRL	WSL	YIELD
65	ATHI RIVER	148/4	9841487	273765	151	41	127	3.18
66	ATHI RIVER	148/4	9841487	273765	166	87	87	6
67	ATHI RIVER	148/4	9841488	275612	192	41	90	45.9
68	ATHI RIVER	148/4	9841488	275612	188	33	121	25.5
69	ATHI RIVER	149/3	9841499	288602	183	61	61	2.34
75	ATHI RIVER	148/4	9845166	270044	98	79	92	4.08
76	ATHI RIVER	148/4	9845166	270044	151	114	130	6.9
77	ATHI RIVER	148/4	9845168	271903	153	36	152	1.32
78	ATHI RIVER	148/4	9845168	271903	135	53	125	15.6
79	ATHI RIVER	148/4	9845168	271903	133	44	125	12.4
160	ATHI RIVER	148/4	9841547	273060	161	24.4	144	9
171	ATHI RIVER	148/4	9841547	273060	245	110	240	12

Environmental, Social and Health Impact Assessment for Proposed Momnai Solar Farm Power Project at Athi River

Map Sheet 7 : Proposed Athi River Power Plant - Distribution of Boreholes

1 0 1 2 3 km

EPSG:21037
Grid North

LEGEND

Borehole

4.2.5 Baseline Ambient Air Quality

The proposed site was evaluated for potential sources of air emissions including fugitive dust and exhaust emissions from vehicles and machinery. Baseline air quality measurements were carried out by NEMA Registered Laboratory. These included Particulate Matter (PM10), Sulphur dioxide (SO2),. Nitrogen dioxides (NO2) and Hydrocarbons (HCs).

4.2.5.1 *Particulate, Matter (PM)*

Particulate Matter (PM) are airborne particles that include dust, smoke and soot. PM can either be emitted naturally (e.g., windblown dust from unpaved roads) or through human activity (e.g., stack emissions). PM is defined by size, with coarse particles being between 2.5-10 microns (µm), fine particles less than 2.5 µm, and ultrafine particles less than 0.1 µm. PM has adverse effects on humans, such as respiratory illnesses (asthma, bronchitis) or cardiovascular diseases and is also considered to be carcinogenic. It can also affect vegetation by inhibiting the plant's photosynthetic properties; by coating the leaves; thereby blocking the penetration of natural light and hindering plant growth.

NEMA ambient air quality guidelines for PM10 and PM2.5 are presented in the **Table 23** below.

Table 23: Air Quality Standards for PM10 and PM2.5

#	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
5.	Respirable Particulate Matter (<10 m) (RPM)	Annual Average*	70 g/m^3	50 g/m^3	50 g/m^3
		24 hours**	150 g/Nm^3	100 g/Nm^3	75 g/Nm^3
6.	PM2.5	Annual Average	35 g/m3		
		24 hours	75 g/m3		

4.2.5.2 *Sulphur Dioxide (SO2)*

Sulphur dioxide is a colourless gas and is characterised as having a sharp, irritant odour. It is a primary pollutant, which can react easily with other substances to form secondary pollutants such as sulphur trioxide and sulfuric acid, amongst others. SO_2 is formed by human activities through mainly industrial processes that contain sulphur, such as the combustion of coal, oil or gas.

SO_2 is damaging to the human respiratory function when inhaled, causing coughing and shortness of breath. Either long term exposure or exposure to a large dose can result in chronic respiratory disease and the risk of acute respiratory illness.

With regards to the impacts on vegetation, SO_2 can inhibit the photosynthetic properties of plants and in some cases, eliminate more sensitive species on the ecosystem level with continuous exposure.

The NEMA guidelines and standards for ambient SO_2 levels are presented in the **Table 24** below.

Table 24: Air Quality Standards for SO2

#	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
1.	Sulphur oxides (SO_X);	Annual Average*	80 g/m^3	60 g/m^3	15 g/m^3
		24 hours**	125 g/m^3	80 g/m^3	30 g/m^3
		Annual Average		0.019 ppm/50 g/m^3	
		Month Average			
		24 Hours		0.048ppm /125 g/m^3	
		One Hour			
		Instant Peak		500 g/m^3	
		Instant Peak (10 min)		0.191 ppm	

4.2.5.3 ***Nitrogen Dioxide (NO2)***

Nitrogen dioxide is a naturally forming gas, characterised as having an irritating odour. Small quantities can be produced by plants, soil and water, but anthropogenic activities, such as the combustion of fossil fuels and biomass, are the sources of most NO_2. Nitrogen dioxide is one of a group of gases called nitrogen oxides (NO_x). While all of these gases are harmful to human health and the environment, NO_2 is of greater concern. It primarily gets in the air from the burning of fuel in vehicles, power plants, and off-road equipment.

Human respiratory tract irritation represents a direct effect of NO_2 exposures. Due to it being relatively insoluble (relative to SO_2), NO_2 can penetrate deep into the lungs, causing potential tissue damage. Effects of NO_2 exposure include alveolar tissue disruption and obstruction of the respiratory bronchioles. Long term effects of exposure include increased potential for lung infections.

The NEMA guidelines and standards for ambient NO_2 levels are presented in the **Table 25** below.

Table 25: Air Quality Standards for NO_2

#	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
3.	Nitrogen Dioxide	Annual Average	150 g/m^3	0.05 ppm	
		Month Average		0.08 ppm	
		24 Hours	100 g/m^3	0.1 ppm	
		One Hour		0.2 ppm	
		Instant Peak		0.5 ppm	

4.2.5.4 Hydrocarbons (HCs)

Hydrocarbon-based gasoline and diesel vehicles and equipment will be used at the site during the construction and operations. These vehicles and equipment will create harmful emissions and polluting exhaust adding to the poor air quality. The cause of the harmful emissions is the incomplete combustion of the fuels that cause the hydrocarbons to react with nitrogen oxides (often produced from high temperatures and oxygen in excess of the amount needed to burn the fuel).

When the resultant gases hit the sunlight, they form ground-level ozone/smog being produced. The Ozone is a very potent irritant and can not only cause eye or throat irritations, but potentially serious lung damage or respiratory trouble to the site workers.

The NEMA guidelines and standards for Hydrocarbons (HCs) levels are presented in the **Table 26** below.

Table 26: Air Quality Standards for HCs

#	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
10.	**Non-methane hydrocarbons**				
		instant Peak	**700ppb**		
11.	**Total VOC**	**24 hours****	**600 g/m3**		
12.	**Ozone**	**1-Hour**	**200 g/m3**	**0.12 ppm**	
		8 hour (instant Peak)	**120 g/m3**	**1.25 ppm**	

a) Assessment Methodology

The assessment of air quality was carried out on 7th February, 2022 at two locations namely:

- Substation site (at co-ordinates 0273024, 9841658)
- Quarry site (at co-ordinates 0271835, 9842774)

The air quality assessment was done with respect to the Environmental Management and Coordination (Air Quality) Regulations 2014, the Second Schedule - 'Priority Air Pollutants' and the Third Schedule – 'Emission Limits for Controlled and Non-Controlled Facilities'. It was also aimed at providing baseline data for future environment management and monitoring.

The method used in the measurement of the air quality is suitable for the determination of the concentrations of pollutant substances in the atmosphere (Ref. BSN 481). A volume of air is drawn through a collection substrate such as a filter mounted on a sampler and the amount of pollutants collected is determined by Gas Chromatography. The sampling methods for determining the level of pollutants has been evaluated in both Laboratory and field based tests to determine their performance with respect to the MDHS 70 - Methods for the Determination of Hazardous Substances, Occupational Medicine and Hygiene Laboratory of the United Kingdom.

b) Interpretation of the Analytical Results

All the parameters analyzed were found to be within the limits contained in the Environmental Management and Coordination Act (Air Quality) Regulations 2014. Refer to **Table 27** below.

Table 27 (a & b): Air Quality Results

a) **Particulate Matter Results**

Sampling Position	Wi (mg)	Wf (mg)	Total volume m^3	Flow rate L/min	Sampling Period (mins)	Weight of PM (mg)	PM mg/N m)
Substation	25.0	25.3	0.01	2	5	0.3	30
Quarry	25.0	25.2	0.01	2	5	0.2	20

b) Other Parameters Results

Sampling Position	Parameters/ Results				
	O2	**Nitrogen dioxides NO2, (ppm)**	**Sulphur dioxide SO2, (ppm)**	**Hydro-carbons HC's (ppm)**	**Carbon Dioxides (CO2)**
Substation	9.27	<0.01	<0.01	33	8.60
Quarry	6.77	3.89	4.63	178	9.04

4.2.6 Ambient Noise

According to the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009, noise pollution means "the emission of uncontrolled noise that is likely to cause danger to human health or damage to the environment". These Regulations prohibit the production of any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Noise is categorized as a physical hazard, and is known to cause workers hearing loss, and also affects body parts other than the hearing organs. Reports have revealed that noise causes mental disturbances, masking of speech, work performance, sleep etc, (Özer & Irmak, 2008). Studies conducted in various countries reveal that the effect of exposure to high noise levels with various frequencies caused noise induced hearing loss of workers exposed to the noise (Bies & Hansen, 1996; Yilmaz & Özer, 2005).

The recommended noise limits to reduce hearing loss (occupational deafness) by International Labour Organization (ILO), World Health Organization and The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009 are:

- 90dB (A) for 8 hours daily as the Occupational Exposure Level (OEL), which most workers can continually be exposed to noise without developing occupational hearing loss in industries.
- For workshops and plant areas where occasional communication is required, the recommended limit is 65 - 85 dB (A).

a) Methodology

The noise level assessment was carried out on 7th February, 2022. The samples were collected from the following locations:

- Quarry Site (at co-ordinates 0271830, 9842674)
- Substation Site (at co-ordinates 0273018, 9841675)

The Standards used during the noise level assessment were:

- The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009.
- The Factories and Other Places of work (Noise Prevention) and Control Rules 2005.

The assessment was undertaken using a Larson Davis 870 precision integrating Sound Level Analyser with 902 pre-amplifier and integrated with a speed monitor. The assessment was conducted in accordance with international noise standards, in particular ISO 1996:1822 - Acoustic Description and Measurement of Environmental Noise, and British Standard (BS) 4112: 1997 – Method of Rating Industrial Noise affecting Mixed and Residential areas. The particular values recorded during the noise assessment were reported as the equivalent continuous sound level (Leq). The A - weighting network is most commonly used in the measurement of industrial and environmental noise because it causes the sensitivity of the meter to vary with the frequency and intensity of the sound like the sensitivity of the human ear.

b) Interpretation of the Results

The noise level assessment undertaken at the proposed project site at Athi River has shown that the locations registered noise levels that complied with the maximum Occupational Exposure Levels (OEL) as contained in the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009. Refer to **Table 28** below.

Table 28: Noise Level Results

Area / Location	Measured Levels [Leq dB(A)] LA eq		Recommended Levels (TLV)	Comments
	Lo	Hi		
Quarry Site	50.90	64.660	90	OK
Substation Site	76.025	77.975	90	OK

4.2.7 Physical Cultural Resources

Archaeological and Cultural Heritage impact assessment has been undertaken to identify and ensure the protection of archaeological and cultural heritage assets associated with the project footprint area/sites to ensure that effective management and mitigation controls are in place.

The field survey established that the proposed site is a currently used as a dumping site. The stratigraphy is disturbed hence very unlikely to contain any archaeological cultural heritage resources. No archaeological features were seen on the surface. There is no preservation of organic remains, such as fossil remains. The archaeological heritage resources documented are, overall, considered to be absent or if any of relatively low sensitivity due to the heavily disturbed nature of the site. The impact of this development on physical cultural heritage resources is expected to be minimal due to the secondary nature of deposits.

However, the absence of archaeological or cultural heritage materials on the surface may not preclude the possibility of their existence in secondary context especially those that may have been introduced from the damping materials in the ground. It is thus recommended that the developer immediately notifies the National Museums of Kenya (NMK) if any archaeological materials are detected/uncovered in the course of project preparing the site for operation. A Chance Finds Procedure (CFP) is provided herewith below for this purpose.

Chance Find Procedures

The Contractor will be expected to apply the following chance find procedure to protect any cultural artefacts that could be encountered during construction.

In cases where culturally valuable materials are uncovered during excavation:

- *Stop work immediately following the discovery of any materials with possible archaeological, historical, paleontological, or other cultural value;*
- *The artefact shall not be moved from where it has been found, unless supervised by an Archaeologist;*
- *Prevent and penalize any unauthorized access to the artefacts;*
- *Announce findings to project manager and notify relevant authorities;*
- *Protect artefacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artefacts;*
- *The Archaeologist together with the contractor and project manager, will undertake an inspection of the cultural heritage site;*
- *In consultation with the project manager and Contractor, the Archaeologist will determine the appropriate course of action to take;*

- *Sensitive sites defined in the Chance Finds Report shall be marked off with hazard tape, detour signs and if necessary, the site secured as detailed in the chance finds report. The site will be secured to prevent any damage or loss of removable object;*
- *Restart construction works only after obtaining authorization from the relevant authorities.*

4.2.8 Protected Area Designations

The project site is not a protected area however the site borders a key biodiversity area i.e. Nairobi National Park. The borders is fenced and secured to prevent animals from trespassing to the proposed site.

4.2.9 Visual Aesthetics

As total 7,938 Nos. of the modules that will be set up in the proposed project site. The presence of such a large number of modules covering an area of approx. 3.55 Ha of PV panels is expected to constitute a risk for glare. The reflection from the PV panels may create a visual impact on local community. Now the Solar PV panel has the anti-reflecting coating, which reduces the sun's reflection from photovoltaic panels. Therefore, the visual impact due to the glare from PV panel will be low.

The project site will be located within an area largely occupied by large industries, there may be moderate visual impact since a permanent road passes next to the Solar Farm. Significant glare impact will be from above.

4.3 Health and Safety

In this project Safety, Health and Accident Prevention is everyone's responsibility. Momnai Energy are sincerely interested in the safety and welfare of their employees, community and environment protection, as such, these safety and health rules are to be strictly observed at all times. A HSE policy will be formulated and hence abuse or disregard of this policy is a violation and will be treated accordingly. Everybody's help in preventing accidents and injuries benefits one and every fellow employee.

The Provision of safe, health and environment friendly working conditions and the maintenance of a healthy and safe environment on the construction site are critical concerns to Momnai Energy. A risk assessment of all hazards during all the phases from site preparation to Decommissioning will be carried out.
The risk assessment will serve to highlight the following:

- Identify potential hazards
- Indicate the potential risk
- Set out controls to reduce/eliminate the potential risk
- Indicate the level of actual risk to personnel after controls have been setup
- Show further actions taken to control the risk

It is expected that Risk assessment will be done for the project before job safety analysis is carried out for each specific task.

Momnai Energy is therefore intending:

- Invest in what is necessary to achieve this vision.
- Work with Contractors to make that vision a reality.

- Provide individuals the opportunity, responsibility and accountability to make the vision happen.

Momnai Energy believe:

- Associates and Contractors have both contractual and moral obligations to adopt the policy vision.
- Each Contractor will integrate Momnai vision within its project management organization, its supervisors, and its employees into the concept of a wholly safe and effective work environment.

Momnai Energy recognize:

- That the vision is achievable if there is commitment to being Incident and Injury Free.

4.4 Biological Environment

The proposed Solar PV Power Plant site in Athi River is located in a disused limestone mining quarry where no habitat restoration has been put in place. Vegetation at this site comprises highly disturbed woodland with low plant diversity dominated by young *Acacia xanthophloea* (Fabaceae, Plate 1) and *Schinus molle* (Anacardiaceae) planted as an edge row near the railway line. An artificial wetland feature on the northern side of the site resulting from waste water disposal from the Bamburi Ready Mix Concrete Factory bordering the site has created lush grass and bush vegetation (Plate 2). *Nicotiana glauca* (Solanaceae), an invasive species, abound in the stock piles and soil heaps in the areas. Nonetheless, the site still holds different species of biodiversity, though in low abundances and diversity for most taxonomic groups.

Plate 1: A patch of young Acacia Xanthophloea at the site

Plate 2: Artificial wetland feature resulting from waste water disposal from the concrete plant

Plate 3: The uneven topography and Hazardous Waste dumping at the site

4.4.1 Ecological Studies

To identify the potential impacts of the proposed solar plant on biodiversity in the study area, guidelines provided by International Finance Corporation's (IFC) Performance Standard 6 were used (IFC, 2012). These guidelines recognize that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development (IFC, 2012). Potential impacts are determined by considering: (i) the location and scale of project activities, (ii) its supply, (iii) the project's proximity to areas of known biodiversity value or areas known to provide ecosystem services; and (iv) the types of technology that will be used (e.g., underground mining versus open pits) to implement it (IFC, 2012).

Using our extensive biodiversity inventory was used to determine the Level of Concern Category (LCC) for the site proposed for the solar farm. This is the levels at which using the information available a decision is made about the vulnerability of the species and habitats where they occur. The LCC is determined by combining the extend of the project coverage (how much area will the project be implemented), expected magnitude of impacts, duration of the anticipated impact and probability of occurrence of the impact. Three levels of sensitivities are provided in this assessment; low (Where this impact would not have a direct influence on the decision to develop in the area); Medium (Where the impact could influence the decision to develop the area unless it is effectively mitigated) and High (Where the impact must have an influence on the decision process to development). Tables 6 and 7 below shows the criteria for assessing and ranking impacts risks. In order to achieve minimum impacts on biodiversity from the project, we applied the mitigation hierarchy recommended by Bennun et al 2021.

A sequence of actions intended to avoid, and where avoidance is not possible, to minimize and, when impacts occur, to restore, and where significant residual impacts remain, offset (Bennun et al. 2021).

Table 29: Criteria for assessing Significance of Impacts *(after IFC 2012)*

Extent		**Magnitude**	
Localized (At localized scale and a few hectares in extent)	**1**	Small and will have no effect on the environment	**0**
Study area (The proposed site and its immediate environs)	**2**	Minor and will not result in an impact on the processes	**2**
Regional (County level)	**3**	Low and will cause a slight impact on the processes	**4**
National (Country)	**4**	Moderate and will result in process continuing but in a modified way	**6**
International (Beyond Kenya)	**5**	High (processes are altered to the extent that they temporarily cease)	**8**
		Very high and results in complete destruction of patterns and permanent cessation of the processes	**10**

Duration		**Probability**	
Very short (0 – 1 Years)	**1**	Highly improbable (<20% chance of occurring)	**1**
Short (1 – 5 Years)	**2**	Improbable (20 – 40% chance of occurring)	**2**
Medium term (5 – 15 years)	**3**	Probable (40% - 70% chance of occurring)	**3**
Long term (>15 years)	**4**	Highly probable (>70% - 90% chance of occurring)	**4**
Permanent	**5**	Definite (>90% chance of occurring)	**5**

***Risk** = (Extent + Duration + Magnitude) x Probability*

Table 30: Ranking of the Significance of Risk

		Probability Consequence (Extent + Duration + Magnitude)																			
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Probability	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	2	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**32**	**34**	**36**	**38**	**40**
	3	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**	**27**	**30**	**33**	**36**	**39**	**42**	**45**	**48**	**51**	**54**	**57**	**60**
	4	**4**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**36**	**40**	**44**	**48**	**52**	**56**	**60**	**64**	**68**	**72**	**76**	**80**
	5	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**

Key		
Low	<30	Where this impact would not have a direct influence on the decision to develop in the area
Medium	30-60	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
High	>60	Where the impact must have an influence on the decision process to development.

Based on the above, a detailed field survey of different species of flora and fauna occurring in the area was conducted. This included Plants, Mammals (bats, small & large mammals) Avifauna (birds), Herpetofauna (reptiles and amphibians) and Invertebrates. The surveys were conducted in February 2022. The key findings on flora and fauna are presented in the sub sections below while the full ecological study report is presented as **Appendix 11** of this report.

The results of flora and fauna surveys are as outlined below.

4.4.1.1 Flora

The vegetation of the proposed Solar PV Power Plant at Athi River is mainly composed of secondary Acacia woodland interspersed with bushed grassland or bare ground. Large spaces are also occupied by herbaceous and invasive species. A total of 95 species were recorded within the study site. Fabaceae was the most dominant family with 15 species with about a half of them being Acacias. There were no rare, endemic or endangered species documented on the study site. However, one species, *Aloe secundiflora* is protected against international trade under CITES. In addition, a high diversity of invasive species dominated by *Nicotiana glauca* was documented. This huge diversity of invasive species represented approximately 15% of the total records and this was occasioned by high human disturbance and waste disposal in the area. Consequently, the proposed solar energy installation (5MWac) would have little or no significant impacts of the vegetation of the area.

4.4.1.2 Fauna

a) Mammals

Mammal species inventory was undertaken using three methods namely; mist-nets (for bats), sherman and snap traps (rodents and shrews) and transect surveys (for lage and medium sized mammals). A total of 4 mammal species of two orders occurred in study site. These included *Papio anubis* (Lesson, 1827) Olive Baboon, *Gerbilliscus nigricaudus* (Peters, 1878) Black-tailed Gerbil, *Mastomys natalensis* (Smith, 1834) Natal Multimammate Mouse and *Arvicanthis nairobae* J.A. Allen, 1909 Nairobi Grass Rat. None of the mammal's species found in the study area are endemic to Kenya or globally threatened. The study area also had very low activity of insectivorous bats (few calls/passes counted in the entire area). The negative impacts/risks to mammals and habitats likely to occur during preparation of land before Solar Farm construction include; loss of habitat and dust pollution. The levels of severity of sensitivity of the two risks is medium; meaning the impacts can influence the decision to develop the area unless effectively mitigated. The impacts to arise during operation of the Solar Farm after commissioning is light pollution and approach to be used to transport power from the plant, whose level of sensitivity is medium. Overall, the proposed Solar Plant in Athi-River site, will have limited negative impacts on mammal species or their habitats, if the recommended risk mitigation measures are implemented during and after Solar Plant construction.

b) Avifauna

A total of 77 bird species within 40 families were documented from the area. Of these species, two are listed in IUCN as threatened i.e. White-backed Vulture *Gyps africanus* (listed as Critically Endangered) *and* Tawny Eagle *Aquila rapax* (listed as Vulnerable). However, the two species were only seen flying high over the study site. Additionally, 15 species recorded at this site are migrants of which 13 are Palearctic and 4 Afro-tropical migrants (3 falling in both categories). Perhaps due to the proximity to Nairobi National Park, the area had substantial number of bush-land birds. Big scavenging birds mainly Marabou Stork, Kites and occasionally, Vultures were observed flying or soaring over the site. Only three typical water-bird species were encountered i.e. Egyptian Goose, Common Greenshank and African Spoonbill. Key potential impacts the project may have on birds, and for which mitigation measures have been suggested include; habitat loss and fragmentation, collision with solar panels, collision with transmission cables and electrocution among others. Given the degraded nature of the site, the project is expected to have minimum negative impacts on birds if the proposed mitigation measures are adhered to.

c) Herpetofauna

Despite being highly disturbed, with no rehabilitation implemented, the Athi River site serves as an ecological "island" with a variety of species. A total of 23 amphibians and reptiles were documented in this area. The herpetofauna biodiversity found here included six amphibians, eight lizards, eight snakes and one tortoise. None of the species are threatened under IUC assessment status. The proposed project is not expected to have major impacts on herpetofauna provided the design includes key mitigation measures such as providing remnant natural corridors for herpetofauna.

d) Invertebrates

A total of 128 species from 19 orders were reported from the site. Baited butterfly traps (BBT), general search and yellow pan trap showed the highest number of specimens collected. Ants and wasps from the order Hymenoptera were the most collected specimens in this site. The paper wasp *Belonogatser* wasp species was the most dominant wasp species in the site and was mainly collected in the BBT.

Flies were the second most collected species in the site. Black and yellow leaf chafer beetle (*Pachnoda sp*) was also a dominant species in the area and was found feeding on the bait set in the BBT. The collection was done in the dry period when most invertebrates undergo aestivation and therefore the number of species given here is in no way the total number found in the area.

4.4.2 Conclusion

The area is a small, highly degraded patch of land amidst factories, busy road and railway line. As such it holds low biodiversity, most of which does not trigger a critical habitat status under the IFC standards. Furthermore, the site in its current state, as a dumping site for refuse including highly hazardous items like medical waste poses a significant risk to biodiversity and human health. The proposed Solar PV Power Plant installation is therefore deemed a better land-use option for the area provided the designs implement the recommended mitigation measures for minimizing negative impacts on flora and fauna.

4.5 Socio-economic Environment

4.5.1 Socio-economic Profile

Machakos County is strategically located as it borders seven Counties, To the north it is bordered by Embu, Muranga and Kiambu Counties, to the west Nairobi and Kajiado Counties, to the south Makueni County and to the east Kitui County. Agriculture is the main economic activity in the County, which is largely semi-arid. Most of the crops grown include maize, beans, fruits, vegetables and drought-resistant crops such as sorghum and millet. The County also plays host to the open-air market concept with major market days where large amounts of produce are traded. The County is well endowed with mineral resources that are valuable inputs to building and construction industries. The large deposits of sand, limestone and granite have attracted major cement factories in Kenya.

The County is home to major tourist attraction sites. These include Ol Donyo Sabuk National Park, Fourteen Falls, Iveti hills, Lukenya hills, Mcmillian Castle, Kyamwilu gravitational defying area, Komarock shrine, Masaku Footprint Rock in Kiima Kimwe, AIC Mumbuni (the first church in Machakos), wood carving in Wamunyu, Yathui traditional shrine, Masinga dam, Makongo valley, Yatta Plateau, Katoloni Prayer mountain, Maanzoni Sanctuary, Machakos People's Park and Kenyatta Stadium.

The Kenyatta Stadium is a facility that attracts local, national and international events such as soccer, rugby, celebrations among others. In addition, the County hosts beautiful hotels that attract conference and conventional activities.

4.5.2 Industries

Industries in the County are mostly located in Athi River, Mavoko Sub- County. Some of these include cement industries, agro-chemicals industries, steel plants and textile industries in EPZ, among others. Trade across the County is mainly on small scale basis. However, there are large scale businesses like go downs, business parks, industrial parks, malls and supermarkets. These are bound to increase drastically because of development of modern infrastructure across the County.

4.5.3 Background

Mavoko Sub- County is within Machakos County, Mavoko, popularly known as Athi River, is a fast growing industrial town located some 25km southeast of Nairobi. It is fairly industrialized, it is home to Mabati Rolling Mills, Kenya Meat Commission, Agrichem & Tools, Athi River Steel Plant, Primarosa, Simba Cement, Bamburi Cement, Mombasa Cement, Ndovu Cement, East African Portland Cement, Savannah Cement, National Cement, Poly Tanks, Athi River Mining and Export Processing Zone (EPZ)

4.5.4 Project Area Administration

Administratively, Machakos County is sub-divided into eight sub-counties/constituencies, namely Mavoko, Kathiani, Machakos, Matungulu, Yatta, Masinga, Mwala, and Kangundo. The eight sub-counties are further sub-divided into twenty-two divisions, seventy-five locations and two hundred and thirty- nine sub-locations as shown in **Table 31** below.

Table 31: Area and Administrative Units by Sub-County

	Sub-County	Divisions	Locations	Sub-locations	Area (Km^2)
1	Machakos Town	2	13	39	925,5
2	Mavoko	4	7	14	843.2
3	Kathiani	1	4	21	207.1
4	Yatta	3	8	23	1,057.35
5	Masinga	2	9	29	1,402.8
6	Mwala	4	15	58	1,017.9
7	Matungulu	3	10	30	577.5
8	Kangundo	3	9	25	177.2
	Total	**22**	**75**	**239**	**6,208.2**

Source: County Integrated Development Plan of Machakos2018-2022

The table above indicates that Mwala Sub- County has the highest number of administrative units with 15 locations and 58 sub-locations. Mavoko Sub- County has the lowest number of sub-locations at 14. Though Kathiani has lowest number of locations. 4, it has more sub-locations compared to Mavoko Sub- County.

Mavoko Sub-County has four divisions namely Athi River, Kinanie, Muthwani and Syokimau/Mlolongo. The project will be within Athi River Division, Mavoko Location, Mavoko Sub-Location.

4.5.5 Population and Household Characteristics

4.5.5.1 Demographic Characteristics

The population and density distribution for Sub counties in Machakos County is given in **Table 32** below.

Table 32: Population and Density Distribution by Sub-county

Constituency/ Sub-county	2009 (Census)		2018 (Projections)		2020 (Projections)		2022 (Projections)	
	Pop.	Density (Km^2)	Pop.	Density (Km^2)	Pop.	Density (Km^2)	Pop.	Density (Km^2)
Masinga	125,940	90	163,499	117	173,262	124	183,608	131
Yatta	147,579	140	191,591	181	203,032	192	215,156	203
Kangundo	94,367	533	122,510	691	129,826	733	137,578	776
Matungulu	124,736	216	161,936	280	171,606	297	181,853	315
Kathiani	104,217	503	135,297	653	143,377	692	151,938	734
Mavoko	139,502	165	181,105	215	191,920	228	203,381	241
Machakos	199,211	215	258,621	280	274,065	296	290,431	314
Mwala	163,032	160	211,653	208	224,291	220	237,685	234
TOTAL	**1,098,584**	**177**	**1,426,212**	**230**	**1,511,378**	**243**	**1,601,63**	**258**

Source: County Integrated Development Plan of Machakos2018-2022

Machakos County in general is inhabited by the Akamba community with major towns being cosmopolitan. The total population of the County was 1,421,937 as per the 20199 Kenya Population and Housing Census. This comprised of 710,707 male and 711,191 females. The population density and distribution in the County is mainly determined by the economic activities carried out in the specific sub-counties. As at 2019, the County had a population density of 177 per Km^2.

4.5.6 Population and Livelihood Outlook in Mavoko Sub-County

The population demographic data is secondary obtained from Kenya Population and Housing Census- Kenya National Bureau of Statistics (2019). The total population of Mavoko stood at 322,498 (three hundred twenty-two thousand four hundred and ninety-eight). This comprised of 164,322 (one hundred sixty-four thousand three hundred and twenty-two) males and 158,172 (one hundred fifty-eight thousand one hundred and seventy-two) females. Mavoko is a rapidly expanding industrial and manufacturing base attracting low-skilled workers from all over Kenya making it one of the fastest growing Sub-Counties in Kenya.

Table 33: Population Data for Mavoko Sub-County

County	Sub-County	Urban	
		Gender	Total
Machakos	Mavoko	Male = 164,322	**322,498**
		Female = 158,172	

Source: Kenya National Bureau of Statistics (KNBS) – 2019 Census

4.5.6.1 Household Headship

County statistics for Machakos County reveals that majority of the households are headed by males. Some of the Kenya National Bureau of Statistics (KNBS) data from Machakos on Household Headship are provided below.

Table 34: Distribution of Household Headship by Gender and Poverty Status

Poor				Non-Poor		
County	**Male**	**Female**	**Total Population**	**Male**	**Female**	**Total Population**
Machakos	60.2	39.8	102,667	73.5	26.5	88.605

Source: KNBS

Table 35: Education Level

County/ Constituency	Male				Female			
	None	**Primary**	**Secondary**	**Total Pop**	**None**	**Primary**	**Secondary**	**Total Pop**
Machakos	13.1	58.3	28.6	487,756	16.6	58.1	25.3	502,152
Mavoko Constituency	9.7	43.4	47.0	68,927	11.4	45.3	43.4	56,341
Athi River	9.5	40.0	50.5	24,679	10.5	44.3	45.1	21,530

Source KNBS

4.5.6.2 Religion

According to the KNBS Census carried in 2019, the religious following with the largest population is Christianity (99%).

Table 36: Religion

Religious Following	Population	Percentage
Christian	1,381,248	99.0
Islam	12,984	0.9
Hindu	976	0.1

Source: KNBS 2019 Census

4.5.6.3 Education

Only 27% of Machakos County residents have a secondary level of education or above. Mavoko constituency has the highest share of residents with a secondary level of education or above at 45%. A total of 58% of Machakos County residents have a primary level of education only. Mavoko constituency is 18 percentage points above the county average. Syokimau ward has the highest share of residents with a secondary level of education or above at 52%.. Some 15% of Machakos County residents have no formal education. Since the majority of the project area residents have at least high school level of education, the contractor will have critical human resource pool to recruit both semi-skilled and unskilled workers.

4.5.7 Housing Conditions

In Machakos County, 58% of residents have homes with cement floors, while 40% have earth floors. Less than 1% has wood and just 2% have tile floors. Mavoko constituency has the highest share of cement floors at 83%.

Mavoko constituency is 25 percentage points above the county average. Athi River ward has the highest share of cement floors at 92%. In Machakos County, 3% of residents have homes with concrete roofs, while 89% have corrugated iron sheet roofs. Grass and makuti roofs constitute 5% of homes, and none have mud/dung roofs.

4.5.8 Access to Water and Sanitation

4.5.8.1 Water

Improved sources of water comprise protected spring, protected well, borehole, piped into dwelling, piped and rain water collection while unimproved sources include pond, dam, lake, stream/river, unprotected spring, unprotected well, Jabia, water vendor and others. The KNBS inequality report for Machakos County indicates that in Machakos County, 37% of residents use improved sources of water, with the rest relying on unimproved sources. Use of improved sources is mostly common in male headed households at 39% as compared with female headed households at 33%. Mavoko constituency has the highest share of residents using improved sources of water at 65%.

4.5.8.2 Sanitation

According to the KNBS inequality Report for Machakos County, a total of 61% of residents in Machakos County use improved sanitation, while the rest use unimproved sanitation. Use of improved sanitation is slightly higher in male headed households at 62% compared with female headed households at 52%.

4.5.9 Health Conditions

4.5.9.1 Disease Prevalence (Morbidity)

The Machakos County Integrated Development Plan 2018-2022 indicates that the most prevalent diseases are of respiratory system which account for 46.1% of the total cases reported. This is followed by diseases of the skin which account for 11.2%. To ensure that the project does not contribute to the increase of respiratory diseases, the contractor will put in place mechanism to control dust during construction as outlined in the ESMP. Other diseases prevalent are as shown in **Table 37**.

Table 37: Morbidity in Machakos County

Diseases	Total no. of Cases, 2017	% Contribution
Diseases of respiratory system	640,287	46.1
Diseases of the skin	155,990	11.2
Diarrhea	82,828	6.0
Urinary Tract Infection	71,282	5.1
Arthritis, Joint pains etc.	53,200	3.8
Hypertension	43,578	3.1
Pneumonia	43,323	3.1
Other injuries	40,845	2.9
Eye Infections	29,620	2.1
Intestinal worms	26,242	1.9

Source: Machakos County Integrated Development Plan 2018-2022

Disease Prevalence at the Project Site Area
Records obtained at the nearest heath institution to the proposed site indicate the following:

- **Athi River Level 4 Hospital** - *Upper Respiratory Tract Infection (URTI), Hypertension, Urinary Tract Infection (UTI), Musculoskeletal disease and Injuries*
- **Athi River Shalom Community Hospital –** *Upper Respiratory Tract Infections (URTI), Urinary Tract Infections (UTI), Tonsillitis, Diabetes and HTN*
- **Subcounty Public Health Office, Mavoko Subcounty –** *Diarrhoeal Diseases, Urinary Tract Infection, Upper Respiratory Tract Infection (URTI) and Skin Diseases*

4.5.9.2 Health Facilities

The construction of health facilities programme through Economic Stimulus Programme (ESP) and Constituency Development Fund (CDF) led to increase in health facilities in all sub-counties. The County Government has greatly improved the health facilities with one Level 5 hospital located at Machakos town and four Level 4 hospitals in Kathiani, Mwala, Matuu and Kangundo. Other health facilities by ownership include 193 under the County Government, 32 owned by FBOs, 9 owned by NGOs and 128 private-owned. The total health facilities in the County are 367. Most of the health facilities are found in the urban areas. Patients/clients in rural areas travel longer distances to access health services. In response, the County Government has instituted measures to ensure access to well-equipped health centres within the wards.

Table 38:Distribution of Health Facilities by Ownership

Sub-County	Faith Based	Ministry	NGO	Private	Total
Athi River	3	6	4	41	54
Kangundo	2	16	0	19	37
Kathiani	5	19	0	4	28
Machakos	8	35	1	17	61
Masinga	3	43	0	3	49
Matungulu	0	17	0	21	38
Mwala	7	28	2	12	49
Yatta	4	34	2	11	51
Total	**32**	**198**	**9**	**128**	**367**

Source Kenya Health Master Plan Facility List

4.5.9.3 Nearest Health Institution to Project Site

The nearest health institutions to the proposed project site include Athi River Level 4 Hospital (Public Hospital) and Athi River Shalom Community Hospital (Private Hospital). Shalom Community Hospital is the nearest health facility located within 2km from the proposed site and should be able to handle any emergency cases.

4.5.10 Community Challenges

4.5.10.1 Social Problems

a) **Gender Based Violence -** There is significant level of Gender Based Violence in Machakos County especially in informal settlements. In an effort to address these challenges, Machakos has stepped up its fight against GVB by establishing a Gender Based Violence Secretariat. Preliminary findings from research conducted by LVCT Health (2013) reveal that intimate violence is prevalent at 41.3 percent; physical violence account for 31 percent; psychological

violence at 35 percent while Sexual Gender Based violence accounts for 22 percent. Some of the cases go unreported to fear of reprisals from perpetrators. Activities associated with the implementation of the Solar PV Power Plant is likely to generate opportunities for occurrence of GBV during construction and operation given the patriarchal nature of the society. GBV screening guideline has been provided under impact section of this report.

b) **Low income –** Majority of the residents in Athi River are workers in the many industries in the located in the area. Being unskilled workers, they earn near minimum wage.

c) **Housing –** A high proportion of Mavoko's inhabitants live in appalling slum conditions characterised by insecure tenure.

4.5.11 Economic Characteristics

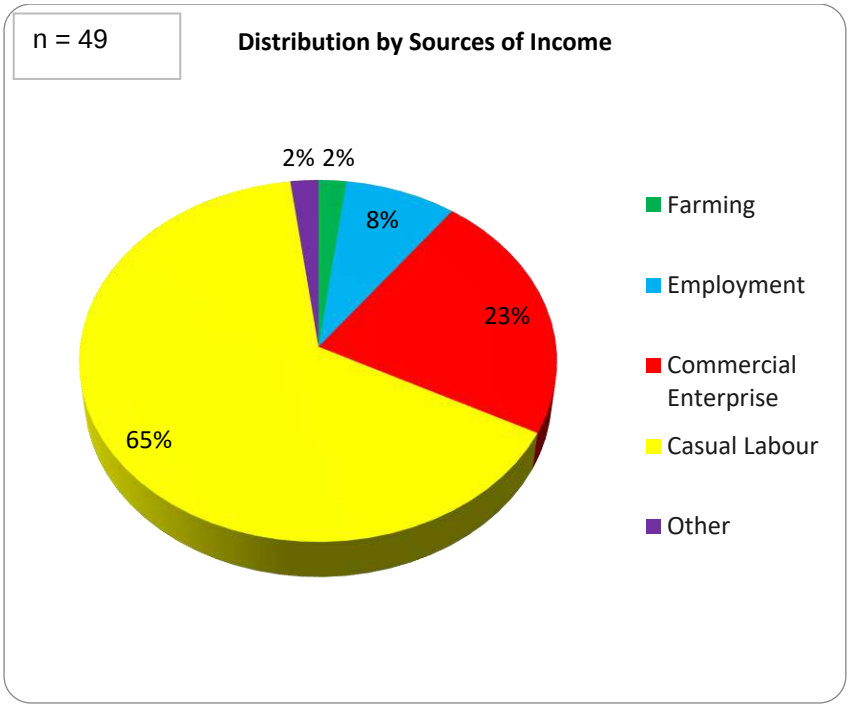
The project is located in Mavoko Sub County which has a population of 322,498 (KNBS, 2019). A total of 49 socio-economic questionnaires were administered to the project area community, comprising mainly of casual workers from the surrounding industries and informal businesses. The project area is sparsely populated surrounded by large factories and the Nairobi National Park.

The information from the data analysis has been presented in the preceding sections.

4.5.11.1 Source of Income

Majority of the population (65%) are engaged as casual labourers. The proposed Solar PV Power Plant will therefore enhance their mainstream economic activity by providing job opportunities as casuals and permanent employees. It is envisioned that the project will impact positively to their livelihoods.

Figure 3: Sources of Income Categories for Persons located next to Project Area

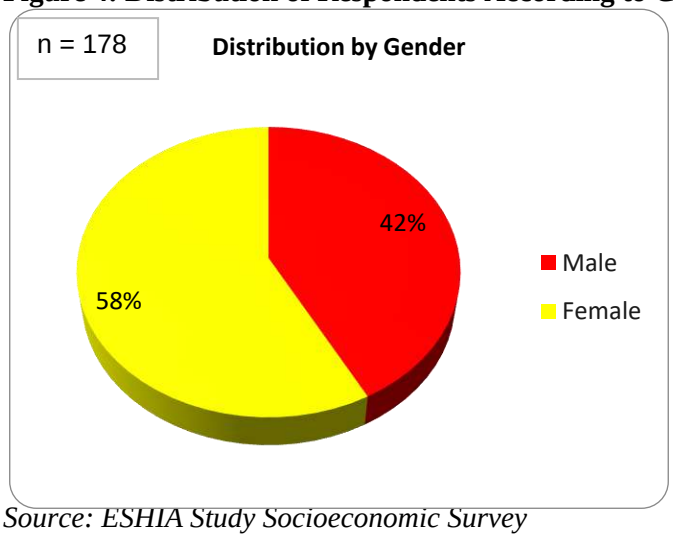


Source: ESHIA Study Socioeconomic Survey

4.5.11.2 Distribution of Respondents by Gender

From the data collected, there are more women 58 percent whereas the men were 42 percent. According to the 2019 Kenya Population and Housing Census, the population of men in Mavoko was at 50.9 percent and women at 49.1 respectively.
The disparity between the National Census figures may have been occasioned by the fact that most men were at their places of employment during the ESHIA survey, this being an industrial area of Machakos County.

Figure 4: Distribution of Respondents According to Gender

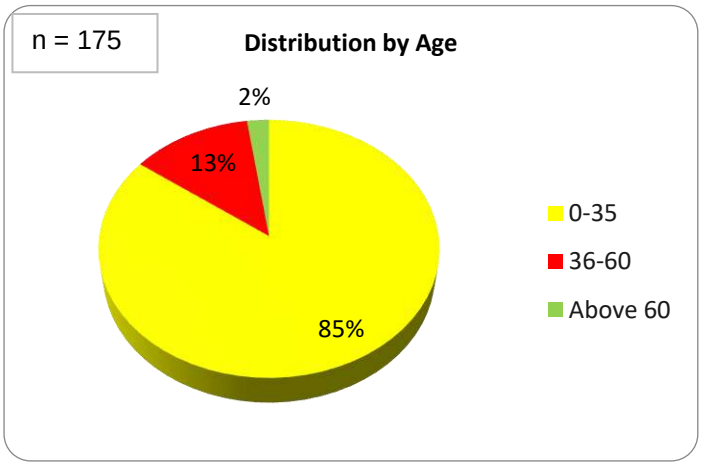


Source: ESHIA Study Socioeconomic Survey

4.5.11.3 Age Distribution of Respondents

Majority of the respondents fall under the age bracket of 0-35years (85%) followed by respondents under the age of 36-60years (13%). Those that fall in the age bracket of 60 years and above (2%). This implies that the population found around the project area are largely economically active. This can be attributed to the youth who have moved in to this area looking for employment in the numerous industrial plants in the area as well as other business opportunities.

Figure 5: Age Distribution of Respondents

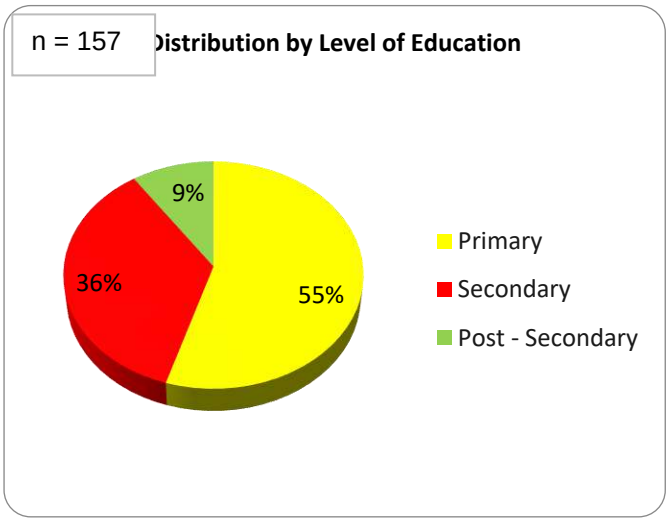


Source: ESHIA Study Socioeconomic Survey

4.5.11.4 Level of Education of the Respondents

Education provides individuals with technical or professional skills and increases their chances and capacity to obtain higher income and standard of living. From the survey literacy level is moderate-good with 58 percent of the respondents having attained primary education and 36% have attained secondary while only 9% have attained post-secondary education. This implies that, the project implementers will be able to communicate with the community and impart any useful information that can make them reap maximum benefits of the project while protecting themselves and the environment.

Figure 6: Level of Education of the Respondents

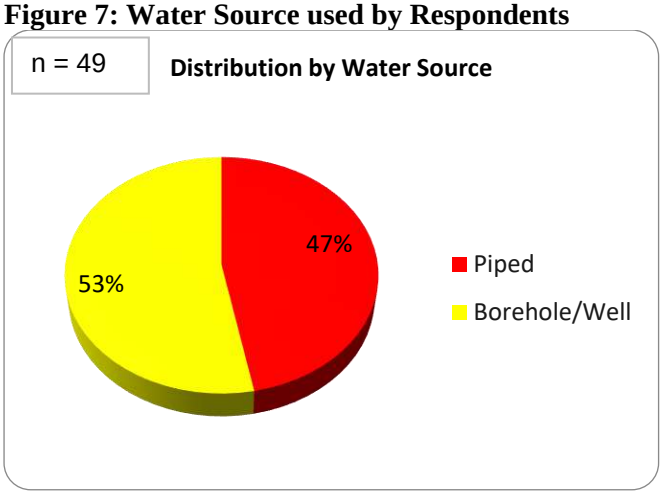


Source: ESHIA Study Socioeconomic Survey

4.5.11.5 Water Source used by Respondents

When the study turned to the respondents' sources of water in Mavoko project area, it was noted as shown in **Figure 7** that majority of them (53%) use piped water. This was followed by Wells and Boreholes (47%). This implies that almost everyone within the project area obtain water from protected sources thus reducing risks of getting water related diseases.

Figure 7: Water Source used by Respondents

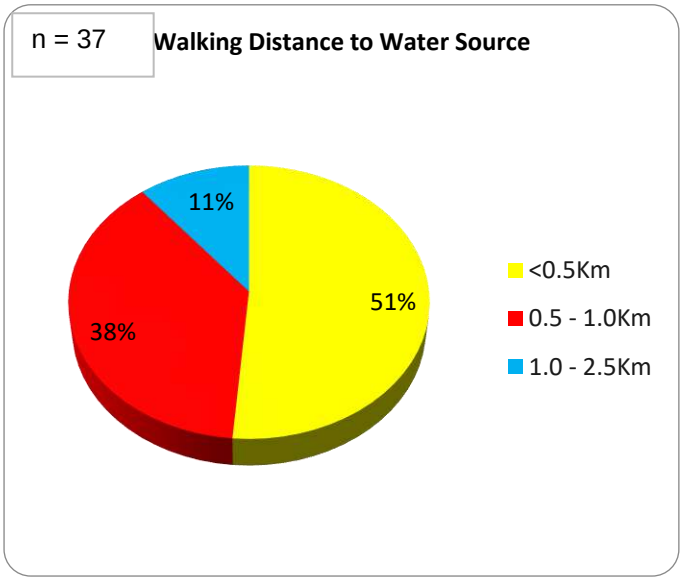


Source: ESHIA Study Socioeconomic Survey

4.5.11.6 Distance to Water Source

Water resources in the County are under pressure from agricultural chemicals and industrial wastes as well as from use of hydroelectric power. The County has two permanent rivers namely Athi and Tana River. Tana River is mainly used for hydroelectricity generation while Athi River used for domestic and industrial uses. Underground water sources supplement surface water sources. The study sought to know the distance respondents cover to obtain water. The findings are reflected on the figure below.

Figure 8: Distance to Water Source

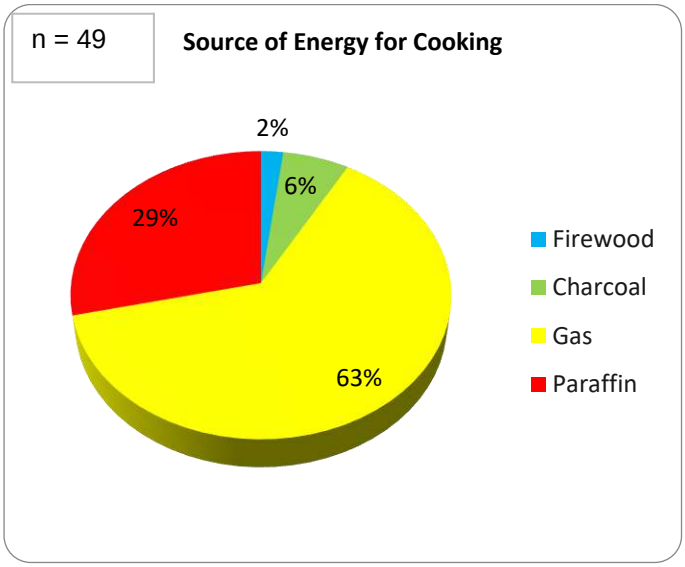


Source: ESHIA Study Socioeconomic Survey

4.5.11.7 Source of Energy for Cooking

The main source of energy used for cooking in Mavoko is gas fuel. About 63 percent of the households rely on gas as their main source of energy for cooking. The choice of cooking fuel can be attributed to Mavoko being a cosmopolitan area. The remaining 37 percent who either use paraffin, charcoal or firewood for cooking should be encouraged to embrace alternative fuel as a way of decelerating deforestation and GHG emission. In the recent past, several initiatives to supply cheap source of energy for cooking targeting the low income level households have been realised. For example, Safaricom has introduced M-Gas where consumers pay KShs 250.00 for the installation of the infrastructure that includes burner, cylinder and gas. Thereafter, the consumer can access the gas with as little as paying KShs20.00 for a token.

Figure 9: Source of Energy for Cooking

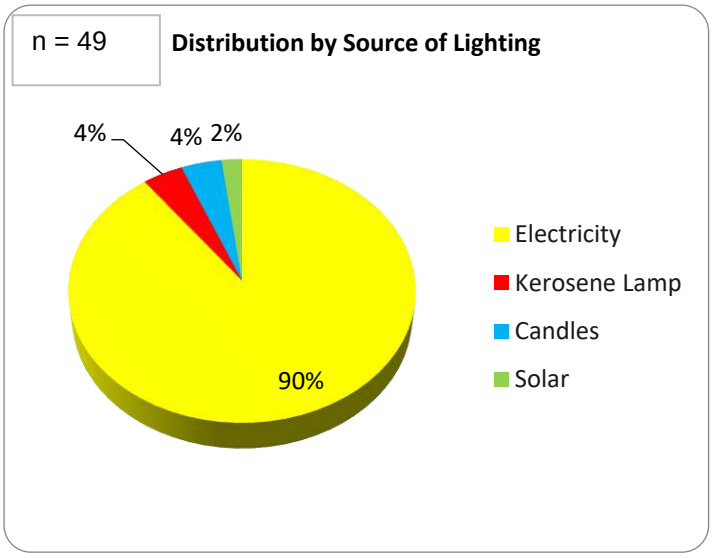


Source: ESHIA Study Socioeconomic Survey

4.5.11.8 Source of Energy for Lighting

As shown on **Figure 10** below the main source of energy for lighting is electricity (90%) followed by kerosene lamps and candles at (4%) respectively. Solar energy is yet to take root in the area, as evidenced from the survey that only (2%) utilize solar for lighting. The high percentage of electricity connection has been made possible by the Government initiative of Last Mile Connectivity Project.

Figure 10: Source of Energy for Lighting

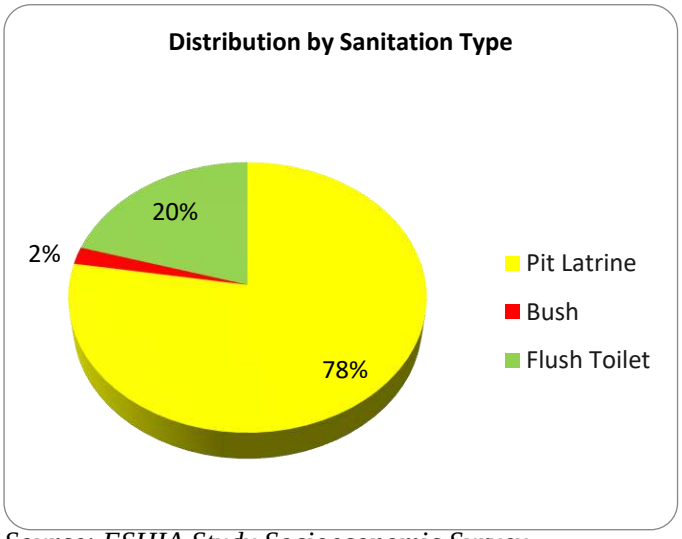


Source: ESHIA Study Socioeconomic Survey

4.5.11.9 Sanitation Facilities

A very large population of the respondents (78%) use pit latrines. Refer to **Figure 11**. Water borne sanitary facilities are probably rare due to the high cost of installation/operation and its high-water consumption. It is noted that although this is an urban setup, sanitary hygiene standards are low owing to the fact (2%) use flying toilets or bush for the call of nature.

Figure 11: Sanitation Facilities

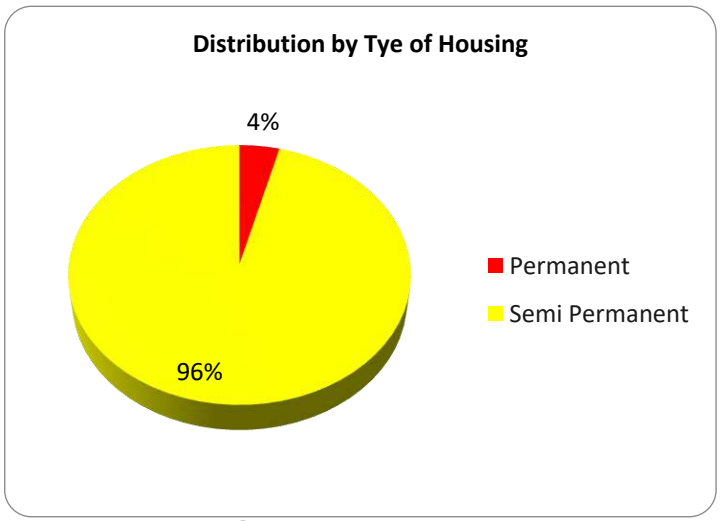


Source: ESHIA Study Socioeconomic Survey

4.5.11.10 Quality of Housing

In terms of housing quality, majority of the community members reside in semi-permanent houses (96%), the rest have permanent houses (4%). See **Figure 12** This implies that although the project will be in an industrialized area, the income levels are low. Efforts need to be made to uplift the living standards of the community.

Figure 12: Quality of Housings

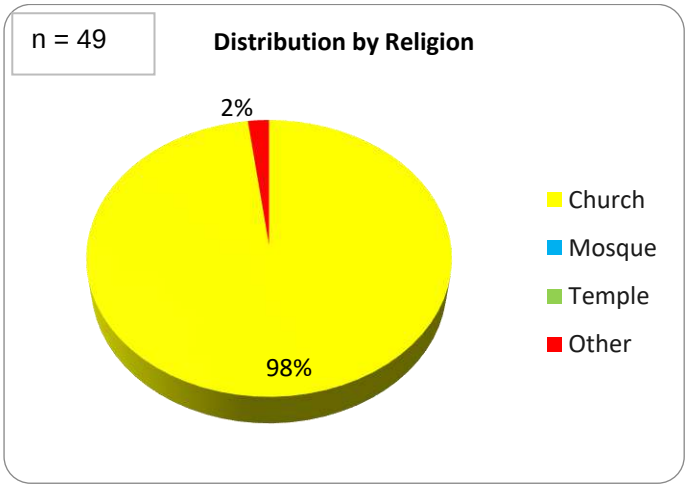


Source: ESHIA Study Socioeconomic Survey

4.5.11.11 Religious Following

The majority of the residents within the project area are Christians accounting for (98%) of the respondents. The other (2%) do not ascribe to any religion.

Figure 13: Quality of Housings

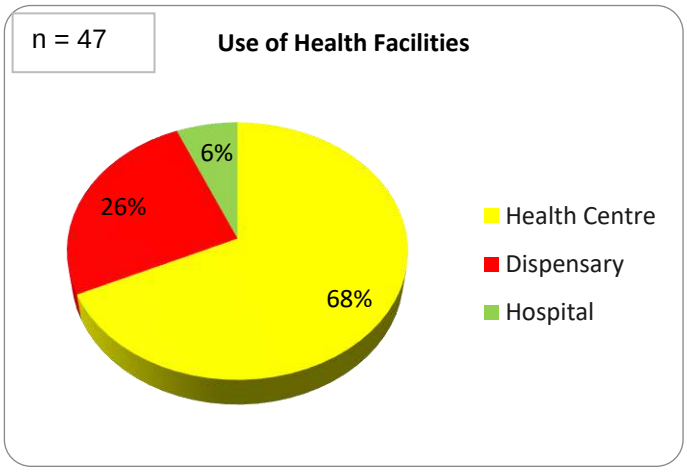


Source: ESHIA Study Socioeconomic Survey

4.5.11.12 Utilisation of Health Institutions

Majority of the respondents visit health centres for treatment (68%). 26% visit the dispensary while only 6% go to hospitals. Fewer respondents visit the hospital probably due to higher costs associated with treatment.

Figure 14: Utilization of Health Facilities

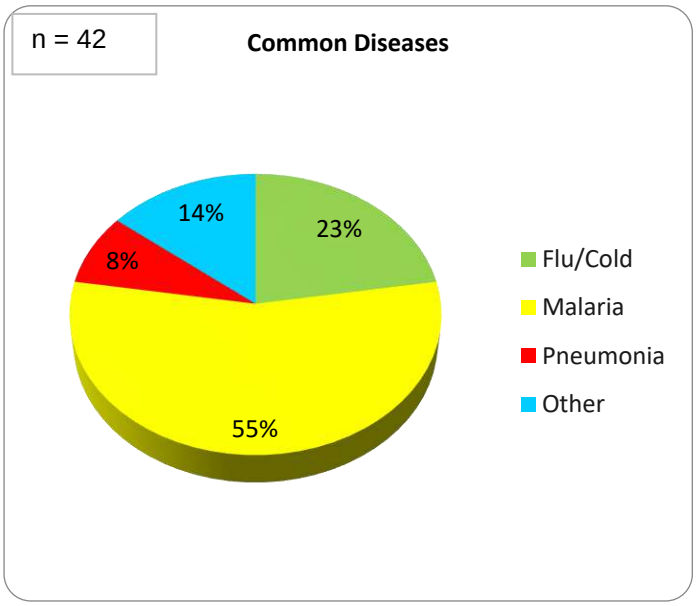


Source: ESHIA Study Socioeconomic Survey

4.5.11.13 Prevalent Diseases

Even though the statistics from Machakos County indicates that respiratory diseases are the most prevalent, the majority of the respondents (55%) indicated that malaria is the prevalent disease that affect the community of the project area. This is followed by Flu/Cold at 23% and other diseases at 14% Pneumonia.

Figure 15: Prevalent Diseases

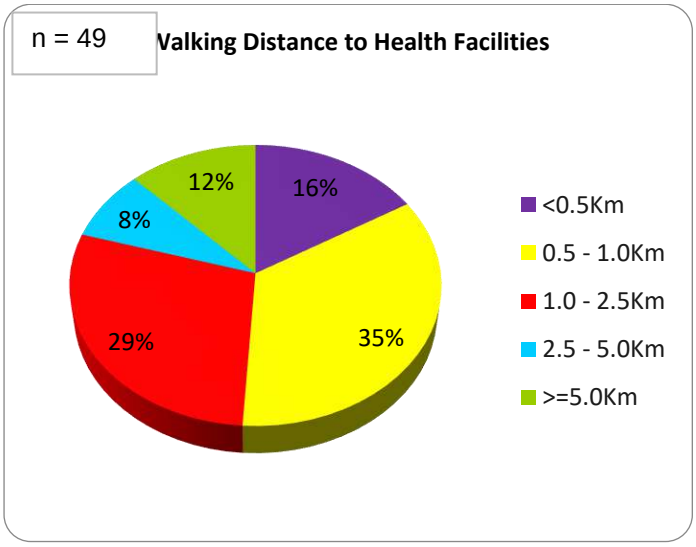


Source: ESHIA Study Socioeconomic Survey

4.5.11.14 Distance to Health Facility

Figure 16 indicates that 12% of the residents live more than 5 kilometres away from a health centre/dispensary. 8% live 2.5-5km away. 29% stay 1-2.5km away, while 35% stay 0.5-1km away from health facilities. Only 16% travel less than 0.5km to reach a health facility. This indicates that only 20% of the residents have to travel more than 2.5km to reach a health facility. The main health facilities within the project area are the Athi River Level 4 Hospital and Athi River Shalom Community Hospital.

Figure 16: Distance to Health Facility

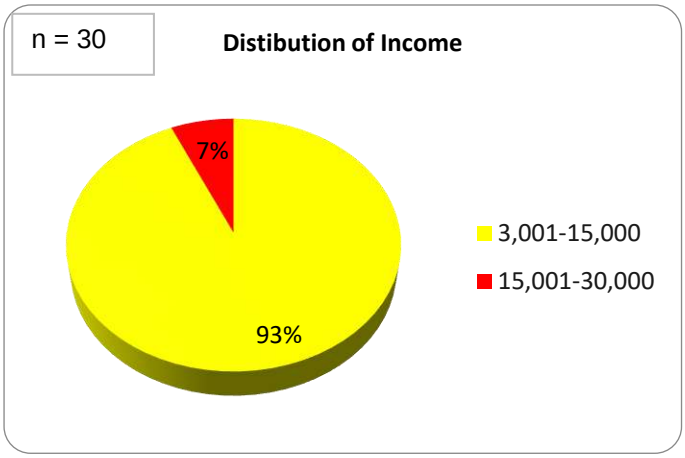


Source: ESHIA Study Socioeconomic Survey

4.5.11.15 Distribution of Income Levels

Majority of the residents have an income of between KShs 3,000- 15,000. See **Figure 17**. A minority have an income of between KShs 15,000 - 30000 per month (7%). This is a significant number to be sustaining themselves below the current set minimum wage.

Figure 17: Distribution of Income Levels

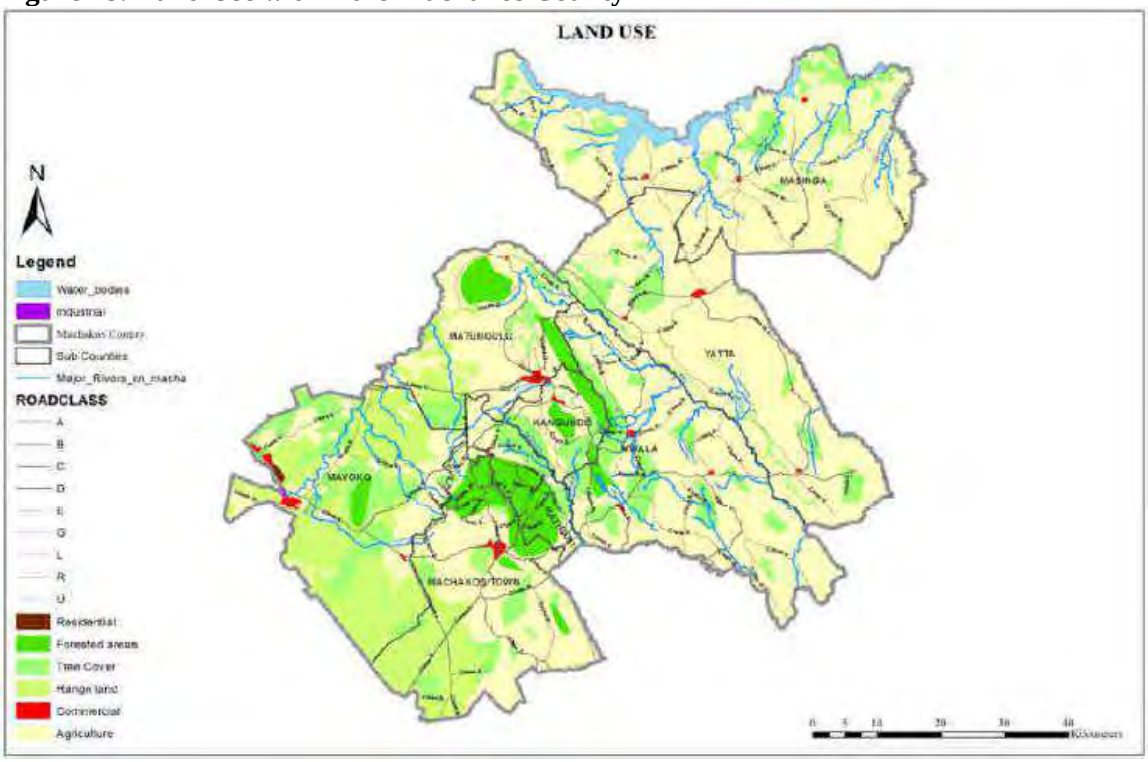


Source: ESHIA Study Socioeconomic Survey

4.5.12 Road's Access

There is an access road off the Nairobi – Namanga road at the junction near Athi River Shalom Community Hospital that connects to the project area and the existing Nairobi Grinding Plant. The road is largely used by the industries that operate within the project area.

Figure 18: Land Use within the Machakos County



Source: Machakos County Integrated Development Plan, 2018-2022

The project is located in the commercial area.

5 ANALYSIS OF PROJECT ALTERNATIVES

5.1 Alternative Location of Site

Solar projects are non-polluting energy generation projects which are site-specific and dependent on the availability of solar irradiance resource. Advantages of the selected site:

- There are no settlements at the site;
- The site was being used as an illegal dumpsite for hazardous materials by members of the public hence use of the site for Solar PV Power Plant will protect it from further pollution by the dumped hazardous materials;
- The site is a designated industrial area hence there is more compatibility of the project with the environs;
- The substation where the power will be evacuated to is located a short distance away (2km);
- Being site that has been excavated for raw materials, the existence of cultural property of archaeological importance is remote and this report provides a "Chance Find Procedure" that will be used by the Contractor to safeguard any findings.

Detailed Ecological Survey was commissioned by the Consultant to evaluate the ecological importance of the site and the appropriate mitigations that the site will require to eliminate or minimize impacts. The ecological impact report has been prepared indicating that the installation of the Solar Plant will not have irreversible impacts on the site, in fact pollution status will actually improve since dumping will stop.

5.2 Analysis of Alternative Energy Sources

Bamburi Cement PLC has been using electrical energy supplied by Kenya Power to carry out its operations at the Nairobi Grinding Plant. The Plant uses a lot of electrical energy which is generated from various energy sources including Hydro-power, Thermal, Geothermal. The thermal energy source is produced by burning fossil fuel. Due to the high demand for power for its operations, Bamburi has decided to go green energy to reduce the emission of GHG. To this end Bamburi has partnered with Momnai Energy to install a 5MWac Solar PV Power Plant at the Athi River Site. An Analysis of Energy sources as provided in **Table 39** indicates that the best alternative clean energy source available that can be exploited is Solar.

Table 39: Types of Energy Sources

Energy Source	Hydro	Thermal Generators	Wind	Geothermal	Biomass Energy	Solar Energy
GHG Emission	Low	High	Low	Low	High	Low
Availability in Kenya	High usage but affected by low water levels. Partially reliable – Clean Energy	Largely used in Commercial Places – Environmental Polluter	High potential, low usage – Clean Energy	High usage/ potential – Clean Energy	High usage – Environmental Polluter	High Potential – Clean Energy

5.3 Ease of Access to the Site

The easter side of the site abuts a permanent road that will be used to access the site with ease. The road is largely used by the industries located within the area hence major impacts on traffic will be easily controlled with appropriate Traffic Management Plans.

5.4 The No Project Scenario

Under the "No Project Option", any potential adverse environmental, social and Health impact associated with the project would not occur. On the other hand, preliminary assessment indicates that the disadvantages with the no project scenario include the following:

- Continued emission of GHG since Bamburi is large power consumer of power that partly generated by burning thermal energy;
- Increased power deficit and load shedding;
- There would be a lost opportunity to promote renewable energy, which would set back the momentum of achieving the Vision 2030 target toward clean energy production;
- Loss of employment opportunities for the local people who could have been employed during the construction and operation phases of the project;
- Loss of government revenue through reduced taxes;
- Loss of business for suppliers and contractors

6 PUBLIC AND STAKEHOLDER CONSULTATIONS AND DISCLOSURE

6.1 Introduction

The overall objective of the exercise is to involve citizens in project formulation and implementation at the local level. More specifically, the objective is to put in place a durable system of intra-community co-operation through collective action, which creates communal discussion forums for the implementation of development activities. The foregoing is particularly pertinent in the context of Article 35 of the Constitution of Kenya which, provides that 'every citizen has the right of access to information held by the state; and information held by another person and required for the exercise or protection of any right or fundamental freedom'. For instance, a question would arise about a project such as Bamburi Solar PV Power Plant and how it affects the local people's right to a clean and healthy environment enshrined in Article 42 of the Constitution of Kenya. This was determined inter alia through subjecting the project to public participation and consultation that is the subject of this chapter.

6.1.1 National Requirements

(a) EMCA 1999 and other National Statutes on Stakeholder Engagement

Within Kenya, EMCA requires a project proponent to seek the views of persons/communities that may be affected by the project to be consulted, at least explain project potential impacts and obtain oral/written comments, which will be included in the ESIA for implementation by the proponent.

The EMCA 1999 calls for effective stakeholder participation and public consultation in the EIA process, in this case ESHIA Study. This chapter elaborates on the Stakeholder Engagement and Public Consultations including Public Consultation Meetings (PCMs) that have been planned for the project area community in Bamburi with regards to the proposed Solar PV Power Plant in Nairobi Grinding Plant in Athi river, Machakos County. Several other Kenyan national statutes also require that stakeholders and communities in project areas, especially where the project is likely to affect their livelihoods directly or indirectly are meaningfully consulted. The EHSIA study recommends that the project developer considers stakeholder concerns during all phases of project implementation (Planning, Construction, Operation, and Decommissioning phases). Key focus should be on the negative impacts of the project. Mitigation measures have been outlined in the ESMP and MP.

6.1.2 International Standards on Stakeholder Engagement

IFC Performance Standard 1 (PS1) and EIB Environmental and Social Standard 1 (S1) were used to guide the process of stakeholder engagement.

6.1.3 Objectives of the Consultation Process

- Identification of significant impacts
- Identification of public's interest and values
- Identification of priorities for assessment
- Encouraging public understanding of the proposed project
- The public can contribute local knowledge and values to the prediction, evaluation and mitigation of impacts
- Improvement in quality and acceptability of ESHIA report
- Public contribute to evaluation of quality and acceptability of report

- Public comment on acceptability of project impacts
- Public evaluate impacts that occur and support project environmental management process

6.2 Stakeholder Analysis

The stakeholder Analysis involved the following process:

- Identification and Mapping of Key Stakeholders
- Defining the mode of consultation and engagement

6.2.1 Stakeholder Identification and Mapping

Stakeholders have been identified according to how they relate or interact with the project. The stakeholders that have been identified are grouped into categories provided in the **Table 40** below.

Table 40: Project Area Stakeholders

No	Stakeholder Grouping	Stakeholders	Stakeholder Category
1	Government	Kenya Wildlife Service (KWS)	Primary
		Ministry of Interior and Coordination of National Government (CC, DCC, ACC, Chiefs, Asst Chiefs and Village Elders))	Secondary
		National Environment Management Authority	Primary
		County Government of Machakos	Primary
		Government Hospitals	Primary
		National Museums of Kenya	Primary
2	Institutions	Kenya Power	Primary
		Kenya Electricity Generating Company	Secondary
		Kenya Electricity Transmission Company	Secondary
		Energy and Petroleum Regulatory Authority (EPRA)	Primary
		Rural Electrification and Renewable Energy Corporation (REREC)	Primary
		Kenya National Highways Authority (KeNHA)	Primary
		Kenya Civil Aviation Authority (KCCA)	Primary
		Churches	Secondary
		Water Resources Authority (WRA)	Primary
3	Local Community	Community Member (Individuals, Households)	Primary
		Businessmen near Project Area	Secondary
4	Others	Community Based Organizations (CBOs)	Secondary
		Non-Governmental Organizations (NGOs)	Secondary
		Local Political Groups (MP, MCAs)	Secondary
		Migrant Workers and Labourers	Primary
		Contractor	Primary

6.2.2 Stakeholder Engagement

A number of consultations were carried out during the EHSIA preparation. The stakeholders consulted include local people, representatives and government officials. The stakeholder engagement involved:

- Key informant interviews;
- Public consultation meetings; and
- Disclosure Meeting

The feedbacks forms from these engagements are described in the following sections.

6.3 Key Informants Interviews

The method used to carry out consultation took into consideration the profile of the stakeholders, type of information desired and level of engagement. Each primary key stakeholder was visited at their offices. There was a session of introduction followed by a brief on the prosed project before the views of the stakeholder were sought through an interactive interview session. Initial engagement with a few key stakeholders was done in November 2021. Further consultations were carried out in February 2022.

Key informants were provided with a Key Informant Questionnaire to fill. Outcome of the interviews are summarized in **Table 41**. The notices, agenda, minutes and attendance register are provided under **Appendix 3**.

Table 41: Project Area Key Stakeholder Questionnaire Analysis

Date	Stakeholder	Participant	Issues Discussed/ Mentioned	Support (Yes/ No)
15/11/2021	Ministry of Interior and Coordination of National Government	• County Commissioner (Machakos) • Deputy County Commissioner (Mavoko) • Assistant County Commissioner (Mavoko) • Chief and Assistant chief (Athi River)	• Solar project overview • Solar project area • Public sensitization and mobilization • Public participation • Benefits of the project to the community • Green energy as a source of power is welcome in the area • Possible employment opportunities • Possible connection to national grid • Security issues in the project area • Hoping for connection to the National grid, which will curb on the short fall of power. • Commends on going green which mitigates climate change and conserves the environment.	Yes
17/11/2021	County Government	• Dept. of Energy, • Lands, Housing and Urban development • Dept of Health and Emergency services. • Dept of Water, Irrigation and Natural Resources • Department of Social Welfare	• Hopes the Solar project will also benefit the surrounding community. • The project should not be in a residential area. • Hopes for mitigation of dust during the construction period. • Power generation capacity and public safety • Possible job opportunities for local community • Social associated with large projects	Yes
Various	Energy Sector	• KETRACO • Kenya Power • KenGen	• Project overview • Placement and arrangement of the Photovoltaic (PV) panels and the subsequent 'glare' effect can be a nuisance to the neighbouring community. • Impacts associated with project activities during: ✓ Construction phase such as noise, dust, influx of foreigners to the area, impacts on soils and water quality, waste generation. ✓ Decommissioning phase such as waste generation and disposal of photovoltaic cells.	Yes

Date	Stakeholder	Participant	Issues Discussed/ Mentioned	Support (Yes/ No)
			• During Construction Phase, mitigation measures should include: ✓ Dust suppression activities ✓ Monitoring of noise levels including restricting construction activities to take place during daytime. Adhering to the Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations, 2009 ✓ Developing and implementing a code of conduct for foreign employees entering into the project area ✓ Adhering to water quality requirements as per the Environmental Management and Coordination (Water Quality) Regulations, 2006 ✓ Adhering to waste disposal requirements as stipulated in the Environmental Management and Coordination (Waste Management) Regulations, 2006 • During Decommissioning phase, mitigation measures should include ✓ Adhering to waste disposal requirements as stipulated in the Environmental Management and Coordination (Waste Management) Regulations, 2006 ✓ To ensure proper disposal of the PV cells.	
16/11/2021 & 10/02/2022	Transport	• KCAA • KeNHA • Kenya Railways	• Project overview • Project design • Project area size • Height of solar panels and pylons • Proximity of project to airport/airstrip , road and railway line • Project should not be on the flight path • Possible glare from the solar panel interfering with flight visibility • If the design has incorporated AAMLE • How long it takes to obtain KCAA	Yes so long as AAMLE requirement are met.
Various	Health Institutions	• Level 5 Hospital Machakos, • Athi River Level 4 Hospital and	• Project overview • Most prevalent illnesses in the area	Yes

Date	Stakeholder	Participant	Issues Discussed/ Mentioned	Support (Yes/ No)
		• Shalom Community Hospital	• Safety and health issues arising from the project must be addressed • Green energy needs to be embraced by more industrialists	
10/2/2022	Neighbouring Business Community	• Poly Tanks • Euro Star • Mold Plast • Exon Industries • Ndovu Cement • Spa Industries • Mombasa Cement	• Project Overview • Good project • Hoping to benefit from the project in terms of supply of the same energy	Ys
17/11/2021	Other Public Institutions	• WRA • KWS • Public Health Office Mavoko	• Disposal and possible recycling of water used for cleaning solar panels • Ensure the project does not interfere with water source or flood waters • More information to be shared about the project • Sanitation • Animal safety	Yes

6.4 Public Consultation Meetings (PCMs)

The Public discussion meeting was held on 9th February at Athi Rive Vocational Training centre in Mavoko Sub-County. The local community and relevant stakeholders including both govt. and private sector representatives were participated in this Public Consultation Meeting. The proceedings commenced at 10:00 am. The meeting was attended by a total of 168 people. The agenda, minutes of the meeting, list of participants and attendance sheets are provided as **Appendix 4** of this report.

Plate 4: Public Consultation Meeting at Athi River

6.4.1 Invitations to the PCMs

Stakeholder engagement becomes a successful exercise when proper and participatory communicative methods are used. This ensures that the stakeholders are kept engaged and well informed of the project development at every stage. A combination of communicative methods is usually used to engage with the stakeholders. Invitation to the meeting was sent out one (1) week in advance to all local leaders, government agencies, community members and the general public. The following media was used to invite participants:

- Individual letters to County Government, Government Departments, Private Companies in the vicinity of the project site;
- Posters distributed through the Chiefs Office; and
- Radio Announcements through popular FM station.

6.4.2 Brief Overview of PCM Deliberations

The following were the issues covered by the proponent, Consultant, Government Agencies and local political leaders,

- Importance of public participation
- Solar project overview
- Project site
- The project designs
- Details of project proponent
- Details of ESHIA consultant
- Generation capacity
- End user of energy
- The study activities that will be carried out
- Possible adverse impacts both socially and environmentally
- Possible CSR activities
- Possible employment opportunities
- Safely measures

Other than the views and important contribution from the National government, energy sector and local political leadership, the general public indicated that they had no questions and they were satisfied with the information presented to them in this meeting. They filled the socio-economic questionnaire and feedback forms. The public embraced the project and seemed not to have burning issues of concern. The full deliberations are captured in the minutes. Refer to **Appendix 4**.

6.5 Overall Outcome of the Consultations

The project area leadership, key stakeholders and community members are excited and support the project since it is a green energy project which is the way to go. Some industries neighbouring the project wanted to know whether:

- They can tap into the energy being generated by the project; and
- What are the requirements to be able to put up such a facility?

6.6 Public Disclosure Meetings (PDM) to Disclose EHIA Findings

Project impacts disclosure meeting was carried out on Friday 22, April 2022. The meeting was convened to disclose the findings of the study and the project mitigation measures that will be carried out to mitigate the identified impacts. It also discussed the next steps in the project process. The following were the main outcome from the disclosure meeting:

- The identified impacts can be mitigated and therefore the project can proceed observing the management plan provided in the report;
- The project area community expect to benefit from the project through employment and that there will be fairness in the engagement i.e. no discrimination or disparity;
- The project area community hoped that the project will not have negative impacts on their health and the environment;
- The project proponent will liaise with the community representatives to identify aa project to be implemented in the community as part of their CSR;
- Both the project area administration and community were satisfied with the impacts identified and the proposed mitigations and therefore gave the project green light to proceed.

The records of the disclosure meeting and register are provided in **Appendix 5.**

Public Disclosure Meeting in Progress at Youth Vocational Centre Athi River (above)

Plate 5: The Area Administration addressing the Public Disclosure Meeting

6.7 Stakeholder Engagement Plan (SEP)

This is an integral part of the larger ESHIA with the aim of guiding the stakeholder consultation processes across the life of the project and during the implementation of the management plans.

The objectives of this plan are aimed at enabling meaningful engagement with stakeholders by identifying different mechanisms for the participation of the said groups. The purpose of the plan is to provide an avenue for affected parties to express their views and opinions and get the appropriate feedback from the project proponent.

6.7.1 Stakeholder Engagement Team

The project developer (Momnai Energy) will set up a team that will oversee implementation of the continuous stakeholder engagement.

This will comprise of the following Officers:

- Sociologist (Grievance Officer);
- Project Administration Officer;
- Site Supervisor;
- EHS Officer.

6.7.2 Grievances

All grievances will be logged in and forwarded to the developers during the construction and operation phase. For any unresolved grievances and grievances related community health and safety, the developer will forward the grievances to Momnai Management who in turn will subsequently forward them to appropriate authority for redress.

6.7.3 Consultations

Consultations with stakeholders will be done by the Project Administration Officer who will also look at the social aspects and work in collaboration with the Sociologist (Grievance Officer) and Site Supervisor and at the site level. Any grievances from the community relating to any issues that might arise from the project activities will be managed by the nominated Grievance Officer based at the Site Office. A grievance desk will be set up at the site and the project implementer will communicate the project area community on how grievances can be lodged.

Consultations with the government agencies will be conducted as per the schedule that will be created with the Site Supervisor of the Developer. All relevant stakeholders will be informed in advance of the planned project activities. The development of the facilities will be based on the ESIA procedures and ESMPs provided in this ESHIA Study Report.

Consultations with the primary stakeholders will involve meetings, information boards announcements and an Intranet system to appraise the project employees regarding the procedures of:

- Emergency response system,
- Incident/accident reporting,
- Grievance redress mechanism,
- Human Resources Policies and Procedures,
- Welfare measures

- Communication of general employment conditions,
- Company's code of conduct for work site,
- EHS concerns,
- Use of PPEs,
- Information and awareness regarding the requirements of labour laws and minimum wages, working hours;
- Worker's code of conduct including Drivers;
- Retrenchment process

The above process should also be conducted with workers engaged by the contractors.

Dissemination of Information

Project related information will be posted on the informational boards at the site office as well as at the Corporate Level. Information on the project milestones will be published in advance on the company's website to be available for the public and non-governmental organizations in the area to comprehend the attitude of the secondary stakeholders. Should any issues be raised by the stakeholders, the project proponent management comprising of the Grievance Redress Committee at the site level shall respond accordingly in the shortest possible time. Details of which have been provided in the Grievance Redress Mechanism section of the report.

A summary of the consultation activities that the project proponent shall undertake as part of the Stakeholder Engagement Plan pertaining to the project area community and other stakeholders have been provided in the **Table** 42

Table 42: Activities to be Performed During Stakeholder Consultations

No	Stakeholder	Information that needs sharing	Timeline	Responsible Entity
1	Project Area Community	• CSR Progress • Information on Jobs • Project subconsultants • Vendors • Environment and safety issues • Grievance redress	Quarterly (throughout project cycle)	• Project Manager • Grievance Officer • Local leaders • Community Representative
2	Migrant and Local Workers	• Grievance redress • Training on how to deal with locals • Safeguards sensitization (Health and safety) • Code of conduct • GBV, SEA and AC issues	Quarterly (throughout project cycle)	• Site Supervisor • EHS Officer • Grievance Officer
3	Government (National and County)	• Permits, Licenses and Approvals) • Unresolved Grievances • Environmental Monitoring Reports	As need arises (throughout project cycle)	• Project Manager • EHS Officer • Grievance Officer
4	Subcontractors	• Training on dealing with locals • EHS matters • Code of conduct for each worker • Safety induction and toolbox talks • GBV, SEA and VAC issues	Quarterly and as need arises throughout project cycle	• Site Supervisor • EHS Officer • Grievance Officer •
5	Project Workers	• Safety induction and tool box talks • Code of conduct • GBV, SEA and VAC issues	Quarterly and as need arises throughout project cycle	• Site Supervisor • EHS Officer • Grievance Officer

No	Stakeholder	Information that needs sharing	Timeline	Responsible Entity
6	Momnai Energy	Regular Reports on project progress	Quarterly and as need arises throughout project cycle	• Project Manager • Site Supervisor • EHS Officer • Grievance Officer

7 SIGNIFICANT ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION

7.1 Introduction

The proposed Athi River Solar PV Project may have an impact on the environment during construction and operation phases. This section assesses the manner in which the Project will interact with elements of the physical, ecological or social environment to generate impacts on the natural environment, resources/receptors. It has been organized as per the construction, operational and decommissioning phases of the project life cycle to understand the risks and impacts associated with each phase During the construction phase, the impacts may be regarded as temporary or short-term; while long-term impacts may be observed during the operation stage. IFC's safeguard policies require that (i) impacts are identified and assessed early in the project cycle; (ii) plans to avoid, minimize, mitigate, or compensate for the potential adverse impacts are developed and implemented; and (iii) affected people are informed and consulted during project preparation and implementation. IFC emphasizes on the use of a screening process as early as possible, to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks.

The impacts are assessed according to each project phase, namely:

- Preconstruction Phase;
- Construction Phase;
- Operation Phase;
- Decommissioning Phase.

7.2 Methodology for Impact Assessment

Environmental assessment was carried out to identify potential impacts of the project on the environment, biodiversity and the community. The assessment was carried out through three main steps, as follows:

- Prediction of potential impacts
- Execution of physical and specialised ecological studies on biodiversity and evaluation and assessment of the impacts in terms of their significance
- Identification/proposing mitigation measures for minimizing the effects of the significant impacts.

After exclusion of the negligible impacts, the remaining aspects were assessed based on the following criteria:

- Magnitude of the impact;
- Duration: period of time that impact lasts;
- Mitigation measures; its availability whether integrated in the project design or implemented as management measures;
- Residual impacts.

Where negative environmental impacts are expected, majority of them will be experienced during the construction phase. To help offset the potential negative impacts, mitigation measures are suggested and the residual impact evaluated.

7.2.1 Identification of Project Impacts

The identification of project impacts was by subjecting the project activities to a process of screening, scooping.

This was an iterative process that comes to an end only when the effects of all the identified impacts generated by the project, including residual impacts have been assessed and assigned a mitigation strategy. The process involved the following steps:

- Impact Prediction;
- Impact evaluation;
- Mitigation and Enhancement;
- Residual Impact Evaluation.

7.2.2 Categorization of Impacts

The key issues identified during the assessment were evaluated using various components that individually or in combination with others give rise to impacts that require mitigation measures and monitoring. The significance of the potential impacts has been considered before and after mitigation measures have been applied

The following criteria was used to evaluate the significance of impact of the solar power project on the physical environment, community and the biological environment

Table 43: Categorization of Impacts

No	Impact	Criteria	Classification
1	Impact Nature	An assessment of the type of effect the activity is likely to have on the surrounding project's environment	***Positive*** *– Affecting the environment positively*
			Negative *– Affecting the environment negatively*
			Neutral *– No effect on the environment*
2	Impact Type	Evaluation of how the impact will affect the project's environment	***Direct*** *– Impacts will be generated directly from project activities*
			Indirect – *Impact generated from secondary sources*
3	Impact Severity	This defines the degree to which the project affects the environment	***Insignificant****– Potential impacts are minor. The natural environment is not affected by the project*
			Low *– There is minimal effect on the natural environment. The social, cultural and natural, cultural and social functions and processes can be reversed to their original state if mitigation measure are applied*
			Medium *– Environment is Impacted but can still function. Negative impacts can only be partially reversed*
			High *– Environmental, Cultural and social functions and processes are Impacted and cannot be fully reversed*
			Very High *- Environmental, Cultural and social functions and processes are Permanently Impacted and cannot be reversed*
4	Impact Duration	The period of time that the impact lasts on the environment	***Short Term*** *– The potential impacts only last for a short time - the period of construction or less.*
			Medium – Term *– The potential impacts last for approximately 10 years or half the lifetime of the project*
			Long – Term *-*
			Permanent But Mitigated - *Impact will remain after operational life of project but appropriate mitigation measures have been used to reduce the impacts*

No	Impact	Criteria	Classification
			Permanent But Not Mitigated - *Impact will remain after an operational life of the project. No mitigation measures will reduce impact after implementation*
5	Impact Extent	Defines the spatial or geographical extent that may be affected by the project or associated facilities	***Project Site*** *– Within the project boundary*
			Local *– Impacts extend beyond the project site*
			Regional *– Impacts extend beyond the administrative area*
			National *– Impacts are considered nationally*
			Transboundary *– impacts are considered beyond the nations boundary*
6	Likelihood of Occurrence	Defines the chances that the impact will take place	***Unlikely*** *– No chance that impact will occur*
			Likely *– There is a good chance that the impact will occur*
			Certain *– The impact will occur whether mitigation measures are implemented or not*
7	Potential for irreplaceable loss of resource	This defines the degree to which the project can cause the loss of a resource that cannot be replaced	***Low*** *– No or minimal impact will occur on irreplaceable resource*
			Medium *– Impacted unique resource can be replaced with mitigation measures after a period of time*
			High *– A high chance the irreplaceable resource will be impacted*
8	Impact Magnitude	This defines the intensity of the change that has the potential to occur	***Insignificant*** *– The magnitude of the impact has no effect on the environment*
			Low - *There is magnitude of the impact has minimal effect on the natural environment*
			Medium-Low *– The magnitude of the impact has some effect on the environment but can be easily reversed with mitigation measures*
			Medium-High *– The magnitude of impact is significant and requires more effort to reverse them through mitigations*
			High *– The intensity of the impact high and only a small and mitigations can only reverse a very small portion.*
			Very High *– The environmental, social and cultural aspects of the project are permanently impacted and mitigation measures cannot reverse the impacts*
9	Impact Significance	The significance will be rated by combining the consequence of the impact and the probability of occurrence	***Negligible – No Action required***
			Low *– The impacts are within the acceptable range*
			Medium-Low *- Impacts are within the acceptable range but should be mitigated to lower significance levels wherever possible*
			Medium-High - Impacts are significant and require attention
			High *- Impacts are of great importance, mitigation is crucial*

No	Impact	Criteria	Classification
			Very High *– Impacts are very significant. Potential impacts such as loss of a significant portion of a valued species or loss of effective ecosystem function*

7.3 Positive Impacts

7.3.1 Climate Change Mitigation and Adaptation

7.3.1.1 Climate Change Mitigations and Adaptation

The solar power project will generate 5 MW of electricity that shall be evacuated to the substation located at the Nairobi Grinding Plant for use by the plant. This amount of electricity from the solar plant will significantly contribute to the reduction of emission of Green House Gases (GHG) and positively impacting climate change. Fossil fuels have been the major culprits on the issue of climate change caused by the release of greenhouse gases such as CO2 into the atmosphere. Consequently, solar energy is among the clean sources of energy one of the. As such, the solar PV power plant will also contribute to reducing the use of fossil fuel resulting in lower greenhouse gases (GHGs) emissions thus promoting the mitigation and adaptation of climate change.

7.3.1.2 Enhancement Measures

During consultations with stakeholders, some companies close to the proposed solar plant showed interest in joining Bamburi/Momnai in tapping into the solar energy to improve power provision for their operations and enhance use of clean energy.

Utility solar in Kenya is just taking root in Kenya, opportunities should be created for expertise and knowledge transfer. The youth should take interest in enhancing their knowledge in the green energy sector. The project can impart skills and knowledge of the solar power technology to the youth through hands on engagement and training.

7.3.2 Improvement of Land Use

7.3.2.1 Current Land Use

The site is currently a disused area that was excavated to provide raw materials for the Nairobi Grinding Plant. The middle section of the site is being used as a dumping site for refuse including highly hazardous materials like asbestos and medical waste which poses a significant risk to biodiversity and human health. The proposed use of the site for solar power generation will halt the dumping of wate at the site. This change of use will improve the site status lower the risk to the biodiversity and to human health that waste is posing.

7.3.2.2 Enhancement Measures

The site can be further improved by planting appropriate indigenous trees in open available spaces at the site and nurturing them to maturity. This will improve ambience and outlook of the project area.

7.3.3 Employment Opportunities for Youths and The Community

7.3.3.1 Employment Opportunities

The project will provide job opportunities for the youth and members of the community. The project will require both skilled and unskilled workers during the construction and operation phases of the project. This will improve the livelihoods status of the community.

7.3.3.2 Enhancement Measures

- The Developer should prepare a Gender Development Plan that will be implemented to promote gender equality in the sharing of available job opportunities as well as supporting the mitigation of gender- based violence and other gender-related issues within the workforce and in the community.
- A staff recruitment strategy should be established and implemented before and during construction to enable the community members be able to access job opportunities.
- Whereas the minimum requirement for employment may be indicated, training opportunities and apprenticeships should be provided to males and females in Bamburi area in order to enhance their skills. This will increase their competence and enhance their chances of getting employed and career development opportunities for the future.

7.3.4 Business Opportunities for the Project Area Community

7.3.4.1 Services to Solar Plant Workers

The workers at the solar plant will require various goods and services to be provided by the community members. This will include laundry, domestic, and transportation services, This will generate good business opportunities for the community members.

7.3.4.2 Enhancement Measures

- Priority should be given to the community of Bamburi area and the immediate neighbourhood of the project to provide goods and services required for the employees of the project.
- Such services should be on an arranged programme in order to make community members offering such services maximise benefits from their services by using the available extra time to tend to their other businesses/opportunities.

7.3.5 Provision of Market for Local Materials

7.3.5.1 Sourcing for Locally Available Materials

During construction, materials that will be used at the solar plant that are available locally shall be sourced locally for the development of the facility. This will create a market for such locally sourced materials and improve the livelihood of businesses that supply such materials/goods.

7.3.5.2 Enhancement Measures

Priority should be given to the local community within Bamburi area for the supply of construction materials and where it is established that such goods are not available locally then the opportunity to supply the goods can be extended to other providers in other areas.

7.3.6 Generation of Electricity

7.3.6.1 Generation of Clean Energy for Use by Bamburi Cement

By generating 5MW of electricity from solar power will contribute to lowering the need to use energy generated from sources that are releasing GHG.

7.3.6.2 Enhancement Measures

Opportunity to supply building materials such as cement, sand and other small accessories and tools should be given to Athi River area community as a first priority. Where it is established that such goods are not available locally then the opportunity to supply the goods can be extended to providers in other areas.

7.4 Project Impacts and Mitigation Measures During Construction Phase

The impacts that will be generated will come from clearing of site vegetation, site excavation, levelling and compaction activities. Operating trucks and other machines are also going to generate impacts during construction. Oils and fuels that have the potential to contaminate soils and pollute water sources will be handled at the project site or could leak from any of the vehicles and machinery working at the site.

The Contractor's office will be generating domestic and sanitary waste that requires appropriate management. Most of the potential impacts occurring during the construction phase are temporary and can be mitigated by applying international and local environmental and social management procedures. The potential impact of each identified activity is discussed and mitigation measures proposed.

7.4.1 Impact of Existing Hazardous Waste at the Site

7.4.1.1 Presence of Hazardous Waste at the Site

The project site has been excavated in the past to provide raw materials for the Nairobi Grinding Plant. Since it is not fenced or secured, members of the public have been dumping hazardous waste in the middle section of the site. It was established that the waste includes disused asbestos roofing tiles, medical waste, chemicals and construction waste among others. The waste needs to be safely removed before any preconstruction or construction activities can commence.

Receptors

The presence of asbestos and other chemical waste at the site poses a health risk to site workers and other persons within the neighbourhood of the site if the asbestos becomes airborne due to poor handling.

7.4.1.2 Impact Assessment

The disused asbestos roofing materials at the site if disturbed may release tiny fibres into the air and if when breathed in may affect the lungs and cause health challenges. Since it is not known where the medical waste and the other chemicals disposed at the site are coming from, unprotected exposure to them may cause health risks.

Table 44: Impact of Existing Hazardous Waste at the Site

Impact	Impact of Hazardous Waste at the Site				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	Impact severity is considered high due to the presence of broken pieces of asbestos at the site heightening the danger of inhalation of dust with asbestos fibers when excavation work is carried out.				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered high due to the health risk exposed by asbestos and other chemicals disposed of at the site.				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered high due to the health risk exposed by asbestos and other chemicals disposed of at the site.				

7.4.1.3 Mitigation Measures

Due to the presence of sensitive receptors within the site and also presence of community settlements and public institutions less than 400m away from the site, management of the solid and liquid wastes becomes critical.

A NEMA Registered Hazard Waste Management expert shall be engaged to prepare a Hazard Waste Management Plan to guide the process of collection, transportation and safe disposal of the collected waste. The Plan shall contain the following:

- Identification of all the hazardous waste present at the site and the approximate quantities;
- The recommended method of collection to avoid generation of unnecessary dust that may contain hazardous materials;
- Safe Transportation and disposal
- Method of verifying that the site has been appropriately cleared for works to commence

7.4.1.4 Significance of Impact

The mitigation measures provided are intended to remove the risk the hazardous waste poses to site workers and other persons visiting the site during construction.. If the mitigation measures are not implemented, the health risk and therefore the impact would remain High.

However, if the proposed mitigation measure is implemented would be significantly reduced and the impact significance would be reduced to low. It is therefore very critical that a registered hazardous waste expert is engaged to remove the waste before commencement of works to eliminate any health risks.

Impact	Scenario	Duration	Extent	Severity	Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Existing Hazardous Waste at the Site	Without Mitigation	Short Term	Local	High	High	High	High
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.2 Air Pollution During Construction

7.4.2.1 Baseline Status of the Site Area

The proposed project is located in an industrial area. Some of the nearest developments to the site are companies that deal in manufacturing of cement and other products. Air Pollutants in the area are from:

- Fugitive dust from movement of vehicles
- Fumes/exhaust emissions from vehicular traffic on the road adjacent to the site. The other source of air pollution in the area is methane from garbage stockpiles and also carbon(iv)oxide from burning of waste at the proposed project site

Potential Sources of Air pollution;

- Construction activities including site clearance, operation of earthmoving and excavation equipment.
- Construction activities that will involve operation of generator sets, movement of vehicles and machinery, during construction this will generate a lot of fugitive dust and exhaust emissions.
- Several trucks will be making regular trips to the construction sites carrying away the excavated soils and bringing in materials for construction.
- The project area receives very little rainfall hence it remains dry for the better part of the year exacerbating fugitive dust situation.

Potential Receptors of Air Impacts

Potential receptors of the air pollution impacts will include the facilities neighbouring the proposed site or situated along the service road leading to site i.e. Nairobi Grinding Plant in Athi river (1km from proposed site), Bamburi Ready Mix Cement Factory (adjacent to site), Poly Tanks (Opposite site the site) , Containers Kenya Ltd(200m) Ndovu Cement(500m), SPA Industry(Opposite the proposed site). Workers will also be impacted by the air pollution from the potential sources on site.

7.4.2.2 Impact Assessment

During construction, significant air pollution impacts will emanate from construction activities and movement of vehicles within the site and outside.

Table 45: Air pollution Impacts from Construction Activities

Impact	**Air pollution Impacts from Construction Activities**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	Impact significance is considered medium low				

7.4.2.3 Mitigation Measures

Contractor to;

- Avoiding equipment and vehicles idling unnecessarily to reduce exhaust emission.
- Suppression of dust by sprinkling water on soil before excavation and periodically when operations are underway to prevent raising of dust.
- Covering of all haulage vehicles carrying sand, aggregate, and cement
- Controlling the speed and operation of construction vehicles, especially over unpaved roads
- Avoiding open burning of solid waste through segregation and recycling, and through disposal according to a solid waste management plan
- Material handling should be done by a competent person, especially when handling hazardous materials during;
- Material handling should be done by a certified waste handler, registered by NEMA
- Educate and raise awareness of construction workers on emission reduction techniques.
- Workers in dusty areas on the site should be issued with appropriate PPE such as, dust masks during dry and windy conditions.
- Monitoring of air quality during and after construction to ensure no major negative impacts occur.

7.4.2.4 Significance of Impact

The air emissions will take place within the proposed site and along the road leading to site i.e. off the old Namanga road. Haulage vehicles along the existing service lane will make trips at specific time of the day and only during the construction phase. The impacts of air pollution will also be felt on site from exhaust and construction activities majorly during the construction phase only.

If mitigations are not implemented the then the impact magnitude is considered medium-low and the impact significance remains medium-low but if the mitigation measures are implemented the impact significance will be low.

Impact	Scenario	Duration	Extent	Severity	Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Air pollution	Without Mitigation	Short Term	Local	Medium	Medium-Low	Medium	Medium-Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.3 Noise Pollution During Construction

7.4.3.1 Baseline status of the project area

The proposed site is located in an industrial setting. The nearest developments to site are manufacturing industries. The activities in the neighbouring industries are expected to continue including vehicle movement along the adjacent road.

Potential Sources of Noise Impact

The construction activities that will generate noise impacts include:

- Construction activities including site preparation, construction of the solar plant infrastructure including foundation, operation of earthmoving and excavation equipment, buildings, and substation construction;
- Operation of diesel generator sets, excavators, graders, bulldozers, dump trucks, vibrating roller, wheel loader, rock breaker, flatbed trucks, concrete trucks, cranes, forklifts and various four-wheel drive and service vehicles
- Transportation of PV modules and mounting structures, construction material, construction machinery, and personnel;
- Digging of trenches to accommodate underground power cables.

Potential Receptors of Noise Impacts

Potential receptors of the noise pollution impacts will include the facilities neighbouring the proposed site or situated along the project access road, Bamburi Ready Mix Cement Factory (adjacent to site), Poly Tanks (Opposite site the site),Containers Kenya Ltd (200m) Ndovu Cement(500m), SPA Industry(Opposite the proposed site) and the Nairobi National Park whose fence is located approx. 70m to the west. Workers will also be impacted by the noise pollution from the potential sources on site.

7.4.3.2 Impact Assessment

During construction, significant noise impact will emanate from construction activities and movement of vehicles within the site and outside.

Site Preparation

The project will involve use of heavy earthmoving equipment and trucks at the construction site which can generate excessive noise and vibrations. Other noises will arise from excessive raving of vehicle and machine engines and also hooting by drivers.

Civil Works and Solar Infrastructure Installation

The construction activities associated with civil works and installation of the solar infrastructure will involve drilling of holes to mount the structures where panels will be mounted, construction of offices, construction of bases for the inverters and transformers. Significant noise will also come from concrete mixers. The support activities that will also generate significant noise levels are the movements of trucks and other vehicles on and offsite.

Table 46: Noise Impacts from Construction Activities

Impact	**Noise Impacts from Construction Activities**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is considered low since noise will be occurring within the site				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The significance of impact is considered low				

7.4.3.3 Mitigation Measures

- Vibrations from compactors during construction may also have effect on neighboring structures hence similar survey should be done on buildings and photo graphic images and video recordings kept to ensure household damages are identified and addressed Contractor shall avoid night time construction when noise is loudest near habited areas or areas.
- There shall be no discretionary use of noisy machinery within 50m of residential areas and near institutions or use of manual labour in these sections
- Contractor shall ensure good maintenance and proper operation of construction machinery.
- Contractor shall ensure that where possible, non-mechanized construction shall be applied to reduce the use of machinery
- Carry out daily noise measurements
- Ensure that all vehicles and construction machinery are kept in good condition all the time to avoid excessive noise generation.
- Ensure that all workers wear ear muffs and other personal protective gear/equipment when working in noisy sections.
- Ensure machines are switched off when not in use.

- Undertake loud noise and vibration level activities during the day (i.e., between 8.00 am and 5.00 pm)
- Construction activities shall be carried out during the day only (8.00am – 05.00pm) to avoid attracting the attention of the wildlife at the Nairobi National Park.

7.4.3.4 Significance of Impact

The noise emissions will largely take place inside the site and along the service lane. The noise levels are manageable. The impact magnitude is considered medium-low and if the mitigation measures are implemented the significance of impact will be very low.

Impact	Scenario	Duration	Extent	Severity	Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Noise Impacts	Without Mitigation	Short Term	Local	Medium	Medium-Low	Medium	Low
	With Mitigation	Short Term	Local	Low	Low	Low	Very Low

7.4.4 Impact on Ecology

7.4.4.1 Baseline of the Site Area Ecology

The site falls within a highly disturbed grassed woodland dominated by several species of *Acacias*; mainly young *Acacia xanthophloea* (Fabaceae), *Schinus molle* (Anacardiaceae) planted on the periphery and invasive species. A small marsh area created by dumping of waste water near the Bamburi Special Products Plant creates a wetland microhabitat although very few wetland species were documented in the area. As a result of the human disturbance, the diversity of invasive species is high, with *Nicotiana glauca* (Solanaceae) dominating the soil mounts and other areas along the disturbance gradient within the study area.

Potential Sources of Impacts

The potential sources of impacts that can affect the ecology of the project site include the following:

- Clearance of site for the project
- Site levelling
- Construction Activities

7.4.4.2 Impact Assessment

The area is a small, highly degraded patch of land amidst factories, busy road and railway line. As such it holds low biodiversity, most of which does not trigger a critical habitat status under the IFC standards. Furthermore, the site in its current state, as a dumping site for refuse including highly hazardous items like medical waste poses a significant risk to biodiversity and human health.

The proposed TL installation is therefore deemed a better land-use option for the area provided the designs are aligned to the recommended mitigation measures that have been put in place to minimize negative impacts on flora and fauna.

Table 47: Impact on Ecology

Impact	Impact on Ecology					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered low due to the already degraded nature of the site					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The significance of impact is considered low due to the already degraded nature of the site					

7.4.4.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on the ecology from construction activities include:

- The Contractor shall ensure the Biodiversity Management Plan is implemented during construction
- The Contractor shall ensure that an emergency response plan for preventing and dealing with emergencies like oil spills is put in place;
- Used or waste oil recovered from generators, vehicles, construction machinery and equipment shall be stored on a paved surface with containment in a secure location at the project site; Appropriate secondary containment capable of containing a larger volume than the largest tank by 10%;
- The waste oil and other hydraulic fluids, which is characterized as hazardous shall either be sold to authorized vendors at frequent intervals; or collected by authorised recyclers;
- Movement of construction and transport vehicles shall be restricted to dedicated routes to minimise any harm to reptiles and small mammals;
- Construction activities shall be planned and undertaken in a phased manner to allow for fauna to migrate to areas that are not being affected by the project;
- There shall be strict prohibition on trapping, hunting or injuring wildlife within the site area and should bring a penalty clause under contractual agreements;
- Project related activities shall be carried out during the day;
- Speed limit of vehicles plying in the project area routes shall be kept low 20-25 km/hr to avoid road kills.
- No waste shall be burnt on site.

7.4.4.4 Significance of Impact

The mitigation measures provided are intended to reduce further impacts on the ecology. If the proposed mitigation measures are put in place , the ecology of the site will improve.

Impact	Scenario	Duration	Extent	Severity	Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact on Ecology	Without Mitigation	Short Term	Local	Low	Low	Low	Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.5 Impact on Flora During Construction

7.4.5.1 Baseline Status of Flora

Site Flora
The study site falls within a highly disturbed grassed woodland dominated by several species of *Acacias*; mainly young *Acacia xanthophloea* (Fabaceae), *Schinus molle* (Anacardiaceae) planted on the periphery and invasive species. A small marsh area created by dumping of waste water new the Bamburi Special Products Plant creates a wetland microhabitat although very few wetland species were documented in the area.

Invasive Species
As a result of human influence, a high diversity of invasive species (14) was recorded representing nearly 15% of the total species in the study site. The most abundant species was *N. glauca*, found occupying newly disturbed ground and soil heap while most of the other invasive species were occurring in low numbers

Potential Sources of Impacts
During construction, there will be clearing of vegetation and removal of top soil. The potential sources of impacts that can affect the ecology of the project site include the following:

- Clearance of site vegetation
- Habitat loss and fragmentation
- Site levelling

7.4.5.2 Impact Assessment

Site Flora
A total of 95 species represented in 76 genera and 33 families (see Annex 1). Six families were represented by at least five or more species with Fabaceae, Asteraceae, Solanaceae, Malvaceae, Poaceae and Acanthaceae being the most dominant respectively. Given the high human disturbance in the project site, there were no rare, endemic or threatened species recorded during the study. However, one family (Asphodelaceae, formerly Aloaceae) represented by one species, *Aloe secundiflora*, has its members protected against international trade under CITES

Invasive Species
The determined impact risk level rating for invasive species is medium.

Table 48: Impact on Flora During Construction

Impact	Impact on Flora During Construction				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is low since the land is now a highly disturbed grassed woodland dominated by several species of Acacias				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered low since the site is already disturbed with scanty vegetation					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered low since the land has been highly disturbed				

7.4.5.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on flora include:

Site Flora

- The mature trees of Schinus molle planted on the periphery of the study site should be left intact where possible since they have stored a lot of carbon over time.
- The few individuals of Aloe secundiflora should be relocated to areas that are not likely to be developed within the project site.
- Since the study area is largely bare, open spaces should be revegetated with indigenous species after the construction phase. The young seedlings should be protected against browsing and nurtured to maturity.

Invasive Species

- Control of invasive species should be done promptly to avoid their population explosions which in turn destabilize the growth of indigenous species or displace them completely. The best approach should be constant physical removal of new germinant and saplings before they mature and deposit seeds into the soil thereby replenishing the soil seed banks
- Vehicles and machinery entering the project site should be subjected to one off cleaning upon arrival to avoid introducing invasive species from other regions. Upon completion of work they should also be cleaned again so that they don't spread such species elsewhere. An invasive species management programme should be developed by Bamburi's Lafarge Ecosystems experts for monitoring and control of the species.

7.4.5.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the flora. If the mitigation measures are not implemented, the impact would low. However, with the proposed mitigation measures in place, the impact on flora would be reduced and the impact significance would turn to positive gain since the site plants will be rejuvenated.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact on Flora	Without Mitigation	Long Term	Project Site	Low	Low	Low	Low
	With Mitigation	Long Term	Project Site	Low	Low	Low	Turn to Positive

7.4.6 Impact on Fauna (Mammals) During Construction

7.4.6.1 Mammals at the Project Site

A total of 4 mammal species of two orders occurred in study site. These included *Papio anubis* (Lesson, 1827) Olive Baboon, *Gerbilliscus nigricaudus* (Peters, 1878) Black-tailed Gerbil, *Mastomys natalensis* (Smith, 1834) Natal Multimammate Mouse and *Arvicanthis nairobae* J.A. Allen, 1909 Nairobi Grass Rat. None of the mammal's species found in the study area are endemic to Kenya or globally threatened. The study area also had very low activity of insectivorous bats (few calls/passes counted in the entire area)

7.4.6.2 Impact Assessment

The negative impacts/risks to mammals and habitats likely to occur during preparation of land before solar farm construction include; loss of habitat and dust pollution. The levels of severity of sensitivity of the two risks is medium; meaning the impacts can influence the decision to develop the area unless effectively mitigated. The impacts to arise during operation of the solar farm after commissioning is light pollution and approach to be used to transport power from the plant, whose level of sensitivity is medium. Overall, the proposed solar plant in Athi-River site, will have limited negative impacts on mammal species or their habitats,

Dispersal and ecological movements of terrestrial animals such as mammals, reptiles, amphibians will be drastically affected by barriers such as "impermeable" fences and the open bare field. This could essentially translate to reduced habitats due to limited access to other habitats that occur on the other side of the solar farm.

Table 49: Impact on Fauna (Mammals) During Construction

Impact	**Impact on Fauna (Mammals) During Construction**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is medium since some of the smaller mammals may still be present in the short vegetation areas				

Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-low since the site is disturbed and the small mammals are habiting in the remaining scanty vegetation				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact magnitude is considered medium-low since some mammals are found at the site				

7.4.6.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on flora include:

- Avoid clearance of vegetation and land preparation the during the rainy season when mammals may be breeding and may affect their local migration
- Clear vegetation from north to south and sequentially in order to allow most mobile rodents recorded in this study time to gradually migrate towards the neighboring Nairobi National Park habitat

7.4.6.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the fauna. If the mitigation measures are not implemented, the impact magnitude would be medium-low. However, with the proposed mitigation measures in place, the impact on fauna would be significantly reduced and the impact significance would be reduced to low. It is therefore important that the proposed mitigations are implemented to ensure the fauna at the site is protected.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact on Fauna (Mammals)	Without Mitigation	Long Term	Local	Medium	Medium-low	Medium	Medium-Low
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.4.7 Impact on Avifauna (Birds) During Construction

7.4.7.1 Birds at the Project Site

A total of 77 bird species within 40 families were documented from the area. Of these species, two are listed in IUCN as threatened i.e., White-backed Vulture *Gyps africanus* (listed as Critically Endangered) *and* Tawny Eagle *Aquila rapax* (listed as Vulnerable). However, the two species were only seen flying high over the study site. Additionally, 15 species recorded at this site are migrants of which 13 are Palearctic and 4 Afro-tropical migrants (3 falling in both categories).

Perhaps due to the proximity to Nairobi National Park, the area had substantial number of bush-land birds. Big scavenging birds mainly Marabou Stork, Kites and occasionally, Vultures were observed flying or soaring over the site. Only three typical water-bird species were encountered i.e., Egyptian Goose, Common Greenshank and African Spoonbill.

7.4.7.2 Impact Assessment

During construction, key potential impacts the project may have on birds, and for which mitigation measures have been suggested include; habitat loss and fragmentation, Given the degraded nature of the site, the project is expected to have minimum negative impacts on birds if the proposed mitigation measures are adhered to. Water birds are of particular interest in this project because they are known to mistake the flat reflective solar PV panel surfaces for water bodies and may get crashed as they attempt to land on them – the so called "Lake Effect.

Placing security flood light in the middle of an isolated area might disorient nocturnal migratory birds which may follow the light as cue for navigation in the same way they use stars, moon, the sun etc. Similarly, some invertebrates such as moths are attracted to UV-light especially at night where they may be exposed to predation or attracting other animals (e.g. birds, bats) that may collide with PV infrastructure.

Table 50: Impact on Avifauna (Birds) During Construction

Impact	**Impact on Avifauna (Birds) During Construction**				
Impact Nature	Positive	Negative	Neutral		
Impact Type	Direct	Indirect			
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is considered low since the area is highly degraded, low in threatened biodiversity and there is already high-level infrastructural developments				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low	Medium	High		
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered low since birds will be under low impact during construction					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is low since birds will be under low threat during construction				

7.4.7.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on flora include:

- Mount solar panels on raised pile, allowing room for vegetation growth below the panels
- Retain/replant some natural vegetation in areas around the solar plant
- Minimize dust at the site by watering the roads and construction area

7.4.7.4 Significance of Impact

During construction, there is low probability that birds will be impacted. Therefore, the severity, magnitude and significance of impact remain low whether with or without mitigation.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact on Avifauna (Birds)	Without Mitigation	Long Term	Local	Low	Low	Low	Low
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.4.8 Impact on Herpetofauna During Construction

7.4.8.1 Reptiles s and Amphibians at the Project Site

A total of 23 species were observed at the Athi River proposed solar farm site. They included six amphibians, eight lizards, eight snakes and one tortoise Most of the species were observed in backfilled areas where vegetation regeneration has started. The most dominant species was Red headed rock agama which virtually occurred everywhere including fresh dumping sites. This demonstrates the human disturbance tolerance level certain species are able to cope with.

7.4.8.2 Impact Assessment

Reptiles and amphibians are sensitive to habitat alteration as a result of removal of vegetation for solar PV plant installation. Subsequently, species loss due to deaths may occur. Hence changes occurring during construction are known to have direct impacts on species microhabitats like burrows, tree backs, stones and other objects used as resting or nesting areas for reptiles and amphibians.

During clearance of vegetation and soil leveling slow crawling and slow-moving animals especially invertebrates may be adversely affected. These animals tend to have small home ranges, and are unlikely to escape quickly in avoiding dangers accessioned by machines clearing vegetation or digging soils.

Table 51: Impact on Herpetofauna (Reptiles and Amphibians) During Construction

Impact	**Impact on Fauna (Reptiles and Amphibians) During Construction**		
Impact Nature	Positive	Negative	Neutral
Impact Type	Direct	Indirect	

Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is considered medium since some reptiles and amphibians will be losing their habitat				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-low since the herpetofauna existing within the site will need to be given a chance to migrate to the neighbouring habitat					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact magnitude is medium-low since the herpetofauna existing within the site will need to be given a chance to migrate to the neighbouring habitat				

7.4.8.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on herprtofauna include:

- Reduce the use of heavy machinery where possible.
- Water sprinkling during construction; Proper disposal of all waste matter emanating from the site.
- Reptiles and amphibians are expected to move between habitats. The fence type should include under-passes that allow movement of crawling animals

7.4.8.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the reptiles and amphibians existing at the project site. If the mitigation measures are not implemented, the impact magnitude would be medium-low. However, with the proposed mitigation measures in place, the impact on herpetofauna would be significantly reduced and the impact significance would be reduced to low. It is therefore important that the proposed mitigations are implemented to ensure the reptiles and amphibians at the site are protected.

Impacts	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impacts on Fauna (Reptiles and Amphibians)	Without Mitigation	Long Term	Local	Medium	Medium-low	Medium	Medium-low
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.4.9 Impacts on Invertebrates During Construction

7.4.9.1 Invertebrates at the Project Site Area

A total of 128 species were recorded from 19 orders. These was from a sample size of 891 invertebrate specimens collected. Wasps and ants (hymenoptera) were the most collected group of invertebrates followed by flies (Diptera) and beetles (Coleoptera) (Fig 6). Common species seen around the site included the butterflies from the Pieridae family, different beetle species, earwigs, spiders, snail shells, isopods, crickets, millipedes and cockroaches. Wolf Spider (Lycosidae) and black and yellow leaf chafer beetle (*Pachnoda sp*) were also common from general search and BBT collections respectively (Plate 21). Baited butterfly traps, general search and yellow pan trap had the highest specimen abundance.

7.4.9.2 Impact Assessment

Disturbance of the habitat by the increase human traffic and vehicles at the site which may cause mass destruction of invertebrates. Some invertebrates such as moths are attracted to UV-light especially at night where they may be exposed to predation or death. Garbage may create micro-habitats for Invertebrates to assemble – sometimes they may have chemical residues that my poison the organisms or enter the food chain.

Table 52: Impacts on Fauna (Invertebrates) During Construction

Impact	**Impact on Fauna (Reptiles and Amphibians)During Construction**				
Impact Nature	Positive	Negative	Neutral		
Impact Type	Direct	Indirect			
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is considered low since there is scanty vegetation and the area is already largely disturbed				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low	Medium	High		
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-low since the invertebrates existing within the site will need to be given a chance to move away				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered medium-low since the invertebrates existing within the site will need to be given a chance to move away				

7.4.9.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on Invertebrates include:

- Unnecessary vegetation clearing and ground excavation/soil movement should be voided e.g. by use of existing access roads
- Appropriate lighting should be considered to avoid interference with invertebrates such as moths that are attracted to light at night.
- Mount solar above ground on post support spikes, rather than heavy foundations, maintaining habitats for both below and above-ground invertebrates

7.4.9.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the invertebrates existing at the project site. If the mitigation measures are not implemented, the impact magnitude would be medium-low. However, with the proposed mitigation measures in place, the impact on invertebrates would be considered significantly reduced and the impact significance would be reduced to low. It is therefore important that the proposed mitigations are implemented to ensure the invertebrates are protected.

Impacts	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impacts on Invertebrates	Without Mitigation	Long Term	Local	low	Medium-low	Medium-Low	Medium-Low
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.4.10 Impact on Site Soil During Construction

7.4.10.1 Baseline Status of Site Soil

The project site was formerly used as a quarry to provide raw materials for Bamburi Cement Grinding plant. A section of the site has also been used by members of the public to dump hazardous waste.

7.4.10.2Impact Assessment

The soil of the site will be subjected to excavation and levelling. The construction activities that will impact on the site soil include the following:

- Vegetation clearance
- Excavation of the stop soil causing soil erosion that can be washed away by surface runoff water into the swamps/wetlands/nearby streams/rivers
- Contamination of surface soils by oils, hydraulic fluids, used batteries, paints, curing chemicals
- Storage of oils fuels and other chemicals at the site;
- Usage of vehicles and machinery that are not well maintained resulting in leakage of fuels and oils to the environment;

Table 53: Impacts on Site Soil During Construction

Impact	**Impact on Site Soil During Construction**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
	Impact severity is considered medium given the current status of waste being dumped at the site and the formers mining activities					
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-low since the site has received impacts from previous activities and the currently it is in a disused status					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The impact significance is considered medium-low since the site has received impacts from previous activities and currently it is in a disused status					

7.4.10.3Mitigation Measures

- Set up measures for spill prevention and measures to prevent seeping of contaminants i.e., designated concrete impervious areas for repairs, refuelling and oiling.
- Products such as lubricants and oils should also be well labelled and stored appropriately at their designated storage areas.
- Prepare and display on site spill response procedures and train all the workers on response management.
- Carry out inspection of all machinery and vehicles working at the do not have any oil, hydraulic fluid or fuel leaks before being used at the site
- Maintain spill response kits at the site office.
- Exercise use of water-based fluids including non-toxic chemicals.
- Ensure that no sanitary or waste water is discharged irrationally and ensure compliance with the set legislation on waste water treatment before discharge

7.4.10.4Significance of Impact

The impacts of soil contamination can be severe if mitigation measures are not implemented. The. The impact magnitude is considered medium-low and if the mitigation measures are implemented the significance of impact will be low.

Impact	Scenario	Duration	Extent	Severity	Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact on soil	Without Mitigation	Short Term	Project Site	Medium	Medium-Low	Medium-Low	Medium-Low
	With Mitigation	Short Term	Project Site	Low	Low	Low	Low

7.4.11 Generation, Storage and Disposal of Solid and Liquid Waste

7.4.11.1Sources of Solid and Liquid and Wastes

Potential Sources of Solid waste

The construction activities that will generate solid waste include:

The civil works and general construction waste; these wastes include metal cuttings, rejected materials, cement bags, cementitious wastes, wire pieces, food wastes and surplus materials, obsolete batteries, tree cuttings. etc.

Receptors

the above wastes if not well managed may Impact on the site soil, fauna), air quality and workers.

7.4.11.2 Impact Assessment

The improper handling of domestic solid waste that includes papers and food wrappings may lead to them littering the site compound and being blown away to neighbouring areas. The other domestic solid wastes may litter the site compound and make it unhealthy for workers. Waste from construction activities if not well handled may pose health and safety risk to workers and other persons visiting the site.

The sanitation facilities at the site must be made to work properly. Septic tanks will require very close monitoring to avoid any overflow that may impact the site and also contaminate the neighbouring properties

Table 54: Generation, Storage and Disposal of Solid and Liquid Waste

Impact	Generation, Storage and Disposal of Solid and Liquid Waste				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High

Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The impact significance is considered low					

7.4.11.3 Mitigation Measures

The mitigation measures for solid and liquid waste at the site are follows

- Following EMCA regulations on Waste Management, 2006 Legal Notice 121, the Contractor should prepare for use an elaborate Waste Management Plan
- The Contractor shall ensure that an emergency response plan for preventing and dealing with emergencies like oil spills is put in place.
- Reducing material residual wastes through accurate estimation of size and quantity.
- Recycle and re-use of construction materials.
- Use of durable long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time.
- Proper storage and handling of materials to prevent damage.
- Reuse of materials and packaging material to reduce waste.
- Disposal of waste to be done by a NEMA licensed waste handler.

7.4.11.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts to the site workers, soil and air quality. The impact significance of the solid and liquid waste during construction activities remains low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Generation, Storage and Disposal of Solid and Liquid Waste	Without Mitigation	Short Term	Local	Low	Low	Low	Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.12 Generation, Storage and Disposal of Hazardous Waste

7.4.12.1 Sources of Hazardous Wastes

The solar power project construction activities include site storage of fuel, oils, paints and other chemicals and servicing and repair of machinery and vehicles will generate hazardous waste. At the end construction, the demobilisation will also generate hazardous waste like used oil. The hazardous wastes include used oils recovered from machines, equipment and vehicles after service, hydraulic fluids, used batteries, paints, curing chemicals etc

Receptors

The above wastes if not well managed may impact on the site soil and air quality.

7.4.12.2 Impact Assessment

Hazardous waste is the most critical waste at this site. Any hazardous waste that finds its way into the soil may be washed off and pollute the nearby streams/rivers. It is therefore critical that none of the hazardous liquid waste finds its way into the soil at the site.

Table 55: Generation, Storage and Disposal of Hazardous Waste

Impact	**Generation, Storage and Disposal of Hazardous Waste**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-low since the groundwater that could be impacted is deep (more than 55m below ground level) and the nearest river passes 800m east of the site				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered medium-low since the groundwater that could be impacted is deep (more than 55m below ground level) and the nearest river passes 800m east of the site				

7.4.12.3 Mitigation Measures

The mitigation measures for the impacts of hazardous waste are:

- The Contractor should prepare an elaborate Hazardous Waste Management Plan
- The Contractor should also prepare an emergency response plan for preventing and dealing with emergencies like oil and fuel spills.
- All fuels, hydraulic fluids, engine oils, recovered used oils, curing chemicals, batteries must be stored on paved floors with containment. No vehicle or machine shall be serviced on bare ground. If the vehicles and have to be serviced at the site, the Contractor must identify a place within the site and construct a garage with leakproof paved floor with containment and having a roof over it to avoid rain washing off oils.
- All hazardous waste shall be/tracked through the use of a chain of custody form so that they can be accounted for.

- The Contractor should ensure that all workers especially drivers of vehicles/machinery and those working at the garage must be trained on the importance of keeping away the hazardous chemicals from reaching the ground or water sources. They should be inducted on prompt reporting of any fuel or oil leak or spillage for emergency clean-up response.
- Used or waste oil recovered from generators, vehicles, construction machinery and equipment shall be stored on a paved surface with containment in a secure location at the project site. Appropriate secondary containment capable of containing 110 percent of the largest tank is to be provided.
- Provide appropriately positioned waste bins (easy to locate and near areas where waste is generated)
- The waste oil and other hydraulic fluids, which is characterized as hazardous shall either be sold to authorized vendors at frequent intervals; or collected by authorised dealers only.

7.4.12.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts to the site workers and soil. If the mitigation measures are not implemented, the impact magnitude would remain Medium-Low. However, with the proposed mitigation measures in place, the impact to the ecosystem would be much reduced and the impact significance would be reduced to low. It is therefore very critical that proposed mitigations are strictly implemented to ensure the community and resources are protected.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Generation, Storage and Disposal of Hazardous Waste	Without Mitigation	Short Term	Local	Medium	High	Medium-Low	Medium Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.13 Impact of Increased Traffic During Construction

7.4.13.1 Traffic Status of the Project Area

The project site is located in an area that is largely occupied by large industries. Majority of the vehicles using the road that neighbors the site are heavy commercial vehicles from different industries that are in the neighbourhood i.e. trucks that deliver or collect goods from Bamburi Cement, Rhino Cement, Poly Tanks among others.

Causes of Increased Traffic

The road tends to get congested some days of the week when many trucks converge at the same time to collect cement products and other goods from industries that use this road The industries around the project area manufacture goods like cement, water tanks and other products that are either distributed by the manufacturers themselves or collected by vehicles belonging to dealers.

7.4.13.2 Impact Assessment

The need for trucks to deliver raw materials to the industries and collect manufactured goods leads to increased traffic especially when these trucks converge at the same time thus causing congestion along the road that serves the project site. Whenever there is such congestion, the trucks are compelled to queue along the roadside to wait for their turn to be served.

Since the road shoulders do not have enough space to accommodate the trucks, part of the usable lanes of the road are is taken up.

The Contractors vehicles will be using this same road, increasing traffic volume thereby causing further congestion. This will have the potential of increased potential for accidents since the contractors' vehicles will be making sharp turns to enter the project site.

Table 56: Impact of Increased Traffic During Construction

Impact	**Impact of Increased Traffic During Construction**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-high since there are no alternative routes.to the site				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered medium-high since the road serving the site sometimes experience congestion				

7.4.13.3 Mitigation Measures

- The Contractor should prepare a Traffic Management Plan to provide safety measures for motorists, contractor workers including diversion routes, road signs and barriers.
- In the Traffic Management Plan, the Contractor shall provide guidance on speed limits and any additional measures to control speed
- The Contractor shall post traffic controllers/marshals at active vehicle movement areas to ensure there is order and observance of traffic requirements.
- The Contractor shall provide temporary legible and reflective road signs to indicate ongoing works and turnings to the site to guide motorists.
- The Contractor shall implement traffic controls to avoid congestion and accidents on the road.
- For the site traffic the Contractor shall ensure that drivers:
  - ✓ Only Park in designated parking areas;
  - ✓ Do not block pedestrian routes;
  - ✓ Do not block traffic routes;

- ✓ Obey the speed limit;
- ✓ Follow the instructions of the traffic marshals.

- The Project Supervisor shall ensure that the Contractor:
  - ✓ Introduces and enforces speed limits particularly in the congested areas;
  - ✓ Reduces the need for reversing vehicles, by introducing a one-way system;
  - ✓ Uses a qualified banksman to control deliveries and reversing vehicles;
  - ✓ Designates loading/unloading areas.
- Drivers and equipment operators sign the code of conduct and drive safely within the project area.

7.4.13.4 Significance of Impact

Traffic impacts will be felt at the service road leading to the site during the construction phase. The impact magnitude is considered medium-high but if the mitigation measures are implemented the significance of impact will be low.

Impact	Scenario	Duration	Extent	Severity	Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact of Increased Traffic	Without Mitigation	Short Term	Local	Medium	Medium-High	Medium-High	Medium-High
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.14 Occupational Health and Safety Risks During Construction

The project workers will be exposed to occupational risks due to handling of heavy machinery, construction noise, electromechanical works etc. Construction activities of site clearing, excavation works, materials delivery, concrete mixing and construction traffic will generate a lot of fugitive dust and this may affect the respiratory system. Sometimes the high temperatures in the project area will expose the workers to difficult working conditions including the temptation to remove safety gear while working in areas that require such safety precaution. Construction sites may be a source of both liquid and solid wastes that may cause health and safety risks to workers.

7.4.14.1 Sources of Occupational Health and Safety Risks

The sources of impact on the health and safety of workers at the solar plant will arise from the following construction activities:

- Site clearing activities
- Excavation works and ground levelling,
- Installation of solar panel structures,
- Mounting of the solar panels
- Construction of offices and other amenities
- Handling of heavy machinery,
- Construction noise,
- Electromechanical works

Receptors

The receptors of occupational safety and health impacts are workers both temporary and long term. The level of exposure to risk will vary from one task to another requiring that the seriousness of mitigations also varies with the level of risk.

7.4.14.2 Impact Assessment of Occupational Health and Safety Risks

Arising from the above-mentioned activities that will take place during construction, the workers and other personnel at the solar plant will be exposed to impacts as follows:

- Injuries associated with operation of machinery
- Injuries arising from loading, unloading and lifting heavy materials
- Health impacts arising from being exposed to fugitive dust and exhaust emissions
- Potential injury from a fall due to working at heights
- Impacts from exposure to excessive noise
- Injury from slips and fall
- Overexertion injuries/illnesses
- Fire due to hot works, smoking, failure in electrical installations
- Injury from project vehicle accidents
- Heat stress arising from working under hot weather

The exposures could cause long term impacts if mitigation measures are not implemented hence the severity of impact has been assessed to be high. However, if mitigation measures are implemented as proposed then the impact significance will be medium high.

Table 57: Occupational Health and Safety Impacts from Construction Activities

Impact	**OSH Impacts from Construction Activities**				
Impact Nature	Positive	Negative	Neutral		
Impact Type	Direct	Indirect			
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low	Medium	High		
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	Impact magnitude is considered medium-high due to the high chance of injury occurring from usage of machinery and other tools				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	Impact significance is considered medium-high due to high chance of injury occurring				

7.4.14.3 Mitigation Measures

The mitigation measures to minimise the potential occupational and health risks include:

- The Contractor should prepare a detailed Occupational Safety and Health Management Plan (OSHMP) that will provide all the required health and safety measures to safeguard the workers.
- The Contractor should prepare an Emergency Response Plan
- The Contractor should prepare a Code of Conduct that inter alia commits to the Implementation of the OSHMP and that also commits at individual level to compliance with OSHMP requirements and standards.
- The Contractor should carry out work assessment and identify hazardous substances and working conditions and include safety measures in the OSHMP
- The Contractor should ensure that all construction machines and equipment are in good working conditions and to manufacturer's specifications to prevent occupational hazards.
- The Contractor should appoint a qualified full-time health and safety advisor and fire marshal on-site for the duration of the construction work.
- Establish Health and Safety committee and provide first aid kits and train first aiders
- Induct and train all construction workers on OHS procedures
- Hold daily (or as appropriate) tool box meetings for all workers
- Provide workers with appropriate personal protective equipment (PPE) and instil a mechanism to ensure appropriate usage;
- Adequate training should be provided to staff about raising awareness about use of Personal Protection Equipment (PPE) and emergency response measures;
- Provide workers with adequate portable drinking water and breaks.
- Train workers on safety procedures/emergency response such as fire, oil and chemical spills.
- Ensure that water is sprayed in dust areas to suppress fugitive dust.
- Work to minimize or altogether eliminate mosquito breeding sites.
- Contractor to provide for medical clinic and nurse within the camp facilities
- Contractor to provide an ambulance vehicle to evacuate for emergency situations
- Provide a whistle-blower policy to ensure wellbeing of whistle-blowers
- Fence off the site with security to avoid unauthorized access to the site
- Provide clean and adequate toilets for workers, these toilets will be to World Health Organisation standards

7.4.14.4 Significance of Impact

The impacts can cause long term impacts to the health and safety of the construction workers hence the severity of the project is considered medium, however if mitigations are implemented, then the magnitude of impact would be low and the impact significance would also be low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Occupational Health and Safety Risks	Without Mitigation	Short Term	Local	Medium	Medium-High	High	Medium-High
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.15 Community Health and Safety During Construction

7.4.15.1 Baseline status of the project area

The project location is largely occupied by industries and majority of people found within the vicinity of the project site are either worker in the various factories in the area, venders of various merchandise including food to truck drivers and persons visiting the area to seek for job opportunities.

7.4.15.2 Impact Assessment of Potential Safety Risks to Community

The exposures to community members will arise from potential accidents occurring from vehicles using the access road to the site. Construction activities and excavation, materials delivery, construction tvehicles will generate a lot of fugitive dust and exhaust emissions that may affect the respiratory system of the community members within the site and those outside the site. The Contractor will be able to absorb a significant number of community members to offer services as unskilled workers or skilled workers at the site. Many of these workers will not had a chance of getting safety training hence exposure to physical injury and accidents is much higher.

Table 58: Community Health and Safety During Construction

Impact	**Community Health and Safety During Construction**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The magnitude impact is considered Medium-High since there is a chance community members will move close to the site and vehicles will be passing close by. Workers from the community have a higher exposure to injuries					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	Workers from the community have a higher exposure to accidents/injuries					

7.4.15.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on the Community Health and Safety from construction activities include:

- Carrying out meetings with community members on safety issues at the project area
- Preparation and implement a Community Engagement Plan
- Through the Community Engagement Plan enhance frequent communication with the community through their representatives to ensure quick resolution to issues.
- Fence off the site with security to avoid unauthorized access to the site
- Carry out regular monitoring and assessment of community health and safety issues with a view to improve on performance
- Contractor to assess travelling routes outside the site and identify any areas of high risk and post traffic marshals to direct traffic appropriately to avoid any accidents.
- Provide guidance to drivers on speed limits and good driving practices

7.4.15.4 Significance of Impact

The impacts may be serious if an accident were to occur involving workers or community members. If mitigation measures are not implemented, the impact magnitude shall remain medium-high. However, if mitigation measures are implemented the impact magnitude shall be low and the impact significance shall remain low

Impact	Scenario	Duration	Extent	Severity	Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Community Health and Safety During Construction	Without Mitigation	Short Term	Local	Medium	Medium-Low	Medium	Medium-Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.4.16 Physical Cultural Resources

Baseline status of the project area

Archaeological and Cultural Heritage impact assessment has been undertaken to identify and ensure the protection of archaeological and cultural heritage assets associated with the project footprint area/sites to ensure that effective management and mitigation controls are in place.

7.4.16.1 Impact Assessment

The field survey established that the proposed site is a currently used as a dumping site. The stratigraphy is disturbed hence very unlikely to contain any archaeological cultural heritage resources. No archaeological features were seen on the surface. A "Chance Find Procedure" has been provided for use by the contractor in the event he comes across any artefact.

Table 59: Impact on Physical Cultural Resources

Impact	Impact on Physical Cultural Resources				
Impact Nature	Positive	Negative	Neutral		
Impact Type	No Physical Cultural Resources present at the site hence no impact				
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	None	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary

	Evaluation done for the project site					
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	None					
Impact Magnitude	None	Low	Medium Low	Medium High	High	Very High
Impact Significance	None					

7.4.16.2Mitigation Measures

The site was previously excavated for raw material used by Bamburi. Site evaluation has been done and a no objection to proceed given.

Chance Find Procedures
The Contractor will be expected to apply the following chance find procedure to protect any cultural artefacts that could be encountered during construction.

In cases where culturally valuable materials are uncovered during excavation:

- *Stop work immediately following the discovery of any materials with possible archaeological, historical, paleontological, or other cultural value;*
- *The artefact shall not be moved from where it has been found, unless supervised by an Archaeologist;*
- *Prevent and penalize any unauthorized access to the artefacts;*
- *Announce findings to project manager and notify relevant authorities;*
- *Protect artefacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artefacts;*
- *The Archaeologist together with the contractor and project manager, will undertake an inspection of the cultural heritage site;*
- *In consultation with the project manager and Contractor, the Archaeologist will determine the appropriate course of action to take;*
- *Sensitive sites defined in the Chance Finds Report shall be marked off with hazard tape, detour signs and if necessary, the site secured as detailed in the chance finds report. The site will be secured to prevent any damage or loss of removable object;*
- *Restart construction works only after obtaining authorization from the relevant authorities.*

7.4.17 Employment Opportunities

7.4.17.1Status of Job Opportunities in Athi River Area

The project falls within Machakos County that borders both Nairobi and Kajiado Counties. Industries in the County are mostly located in Athi River, Mavoko Sub- County. Some of these include cement industries, agro-chemicals industries, steel plants and textile industries in EPZ, among others.. This has attracted a large number of people to migrate from the rural areas to come seek for job opportunities. Majority of them get opportunities to work as unskilled workers therefore earning low wages.

During construction, the project will have clear benefits with regard to local employment opportunities. The project will additionally require various skills and services which may not be available at the local level but certainly on the regional level. The increase in employment opportunities will temporarily lead to an overall increase of income directly and indirectly (through increased demand of other local services). Consequently, food vendors will have new opportunities to sell their commodities to the construction workers. The workers that will be absorbed as employees of the construction company will earn regular income and be able to sustain their families. They also gain in the learning of new skills/transfer of skills while working in the project.

7.4.17.2 Assessment of Positive Impacts of Job Opportunities

The project construction is bound to attract labour from Athi river and its environs. In addition, business opportunities may present themselves attracting businessmen and women locally and far away from the site. This will lead to competition with the community for the available employment opportunities presented by the project. The contractor will have to priorities employment of the locals to avoid conflicts between in migrants and local communities. The influx of people from other areas will increase completion and create

Table 60: Employment Opportunities

Impact	**Employment Opportunities**				
Impact Nature	Positive	Negative	Neutral		
Impact Type	Direct	Indirect			
	The employment opportunities is both direct and indirect				
Impact Severity	Insignificant	Low	Medium	High	Very High
	Due to the high demand for jobs, the opportunity to offer job opportunities will have a huge positive impact to the community				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low	Medium	High		
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	Due to the high demand for jobs the positive impact is considered high				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	Due to the high demand for jobs the positive impact is considered high				

7.4.17.3Mitigation Measures

The contractor will be encouraged to apply the following mitigation measures to enhance the positive impact:

- The local community shall be given preference and there shall be gender parity in the issuance of jobs for unskilled workers to the extent possible;
- Local service providers shall be given priority when looking for subcontractors;
- Preference for job opportunities shall be given to the vulnerable population in the project area of influence (AoI);
- The developer shall establish a mechanism of auditing the project to confirm that job and service provision jobs for subcontractors have been fairly given out so that local labour and resources are is used as much as possible.

7.4.17.4Significance of Impact

By offering job opportunities and absorbing local contractors as subcontractors, the project will be positively impacting the community.

7.4.18 HIV AIDS and Communicable Diseases

7.4.18.1 Baseline Status

Athi River where the project is located is an urban area largely with industries. The HIV prevalence in Machakos County stands at 3.7% against a national figure of 4.9%. The HIV prevalence in Nairobi is relatively higher at 8%. Other communicable diseases are also present

7.4.18.2 Impact Assessment of HIV AIDS and Communicable Diseases

Migration of people from other areas may lead to behavioural influences including prostitution which may increase the spread of communicable diseases such as STIs, HIV/AIDS.

Table 61: HIV AIDS and Communicable Diseases

Impact	**HIV AIDS and Communicable Diseases**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High

	The impact magnitude is considered High due to the probable chance of occurrence				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered Medium-High due to the probable chance of occurrence				

7.4.18.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on the community from construction activities include:

- The Contractor should prepare and implement a HIV/AIDS and Communicable Diseases Management Plan
- Arrange on-site clinic to provide VCT services to construction crew and provision of ARVs for vulnerable community members
- The construction workers may have communicable diseases like TB and HIV which they can transmit to the local community
- Convergence of a significant population seeking jobs is likely to lead to an increase in behavioural change and rise in cases of request for sexual favours resulting in the spread of communicable diseases such as TB, HIV/AIDS and other sexually transmitted diseases
- Sensitize workers and the project area communities on awareness, prevention and management of HIV/AIDS through staff and community training programmes, awareness campaigns, multimedia, and seminars/workshops and during community Barazas.
- Include issues of the sexual offences in the code of conduct for workers to protect women and girls of the project host community.
- Ensure workers are regularly reminded about the code of conduct and the potential consequences if not adhered to.

7.4.18.4 Significance of Impact

The impacts can cause long term effects to the women and girls if mitigation measures are not implemented hence the impact magnitude shall remain high. However, if mitigation measures are implemented the impact magnitude shall be low and the impact significance shall remain low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
HIV AIDS and Communicable Diseases	Without Mitigation	Long Term	Local	High	High	Medium	Medium-High
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.4.19 Labour Influx and Impacts of Construction Camps

7.4.19.1 Baseline Status

Athi River is largely an area with large industries. Workers offering services in these industries reside within the neighbourhood (Mlolongo, Athii River and Kitengela Towns

The project will require both skilled and unskilled labour during construction and operation phases of the project.

7.4.19.2 Impact Assessment of Labour Influx

The project construction is bound to attract labour from surrounding counties of Nairobi and Kajiado.. In addition, business opportunities may present themselves attracting businessmen and women from surrounding areas. There will be competition on job opportunities. This may heighten animosity among project area population and in-migrants

The project is likely to exacerbate any of the various forms of GBV including Rape, SEA, Sexual Harassment and Violence Against Children (VAC). if precautions are not put in place. Project workers may also perpetuate GBV by promising jobs or promotion in exchange for sexual favours. There may be increase in crime perpetrated by dissatisfied and disgruntled members of the public who miss job opportunities.

Table 62: Impacts of Labour Influx

Impact	**Impacts of Labour Influx**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-high due to the large population of low income workers looking for job opportunities				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered high due to the large population of low income workers looking for job opportunities				

7.4.19.3 Mitigation Measures

The mitigation measures to minimise the potential labour influx impacts on the project area The Contractor should prepare and implement a Labour Influx Management Plan to manage labour influx.

- Reduce labour influx by tapping into the local workforce as a priority. Depending on the size and the skill level of the local workforce, a share of the workers required for the project may be recruited locally. This may be easier for unskilled workmen. Specialised workmen may be hired from elsewhere. Local workers may also be trained especially if they are required for the operation of the project.

- Effective contractual obligations for the contractor to adhere to the mitigation of risks against labour influx. Depending on the risk factor, appropriate mitigation measures may be deployed. These may range from engagement with a local community liaison to the use of the District and National Government Authorities in regulating labour issues.
- The works contractor should be required, under its contract, to prepare and enforce a No Sexual Harassment and Non-Discrimination Policy, in accordance with national law as well as to the World Bank Code of Conduct guidelines as a best practice, where applicable.
- The contractor should prepare and implement a Gender Action Plan, to include at minimum:
  - ✓ Gender mainstreaming in employment at the worksite with opportunities provided for females to work, in consonance with local laws and customs
  - ✓ Gender sensitization of workers (this could be done by the HIV/AIDS services provider;
  - ✓ Provision of gender disaggregated bathing, changing, sanitation facilities
  - ✓ Grievance redress mechanisms including non-retaliation.
- The EPC contractor shall be required to have a community engagement and strong grievance mechanisms on matters related to labour.
- All workers to sign employment contract including Code of Conduct
- Sensitize workers on community based social behaviour and conduct.
- Efforts to be geared toward instilling attitudes of tolerance, support and understanding of labour immigrates by the community
- Contractor shall monitor and report on the implementation and effectiveness of the labour influx related mitigation measure.

7.4.19.4Significance of Impact

The labour influx may create a crisis at the project site if quick management action is not taken to manage the situation. If mitigation measures are not implemented; the impact magnitude shall be high and impact significance shall remain medium-high. However, if mitigation measures are implemented the impact magnitude shall be low and the impact significance shall remain low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Labour Influx	Without Mitigation	Long Term	Local	High	High	High	Medium-High
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.4.20 Gender Based Violence-Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH)

7.4.20.1Baseline Status on Gender

Gender-based violence is a problem in Kenya whose nature is multi-faceted. Results from KDHS 2008/2009, revealed that 39 percent of married, divorced or separated women aged 15 to 49 years reported to have suffered some form of violence during their lifetime. Gender-based violence identified as a significant driver of HIV/AIDS in Machakos County. Findings show an increased risk of HIV acquisition among victims of gender-based violence and a positive HIV status being a risk factor for violence.

7.4.20.2 Potential Causes of Gender Impacts

As established in section 4.5.10.1, 41.3% of females in Machakos County face Intimate Partner Violence (IPV) among women seeking HIV Testing and Counselling (HTC) Given the low income status of the population who are likely to seek job opportunities at the project site where women and girls may suffer gender impact due to their low income levels/poverty. This impact refers to sexual exploitation and abuse committed by Project staff against communities and represents a risk at all stages of the Project, especially when employees and community members are not clear about prohibitions against SEA and SH in the Project.

7.4.20.3Impact Assessment of Gender Impacts

There will be job opportunities for skilled and unskilled workers during construction of the solar plant. Due to the significant discrimination against women, there are chances that women may lose out in the opportunities. Children may also be exploited due to low-income levels of the households. Some women may also suffer sexual harassment and request for sexual favours in order to be offered a job. A large influx of male labourers may also lead to an increase in exploitative sexual relationships and human trafficking whereby women and girls are forced into sex work. This predisposes the women and girls to SEA. Potential high labour influx may cause GBV and Violence Against Children (VAC). The gender impacts are noted to be very likely, hence the significance is medium-high.

Table 63: Gender Impacts

Impact	**Gender Impacts**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered Medium-High due to the probable chance of occurrence					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The impact significance is considered Medium-High due to the probable chance of occurrence					

7.4.20.4 Mitigation Measures

The mitigation measures to minimise the potential gender impacts during construction activities include:

- The Contractor should prepare a Harassment/Sexual Exploitation and Hazard and Risk Assessment and Management Plan. This will assist in prevention and tackling the issues of GBV, SEA, SH and VAC.
- The Contractor shall be required to ensure clear human resource policy against Gender-based violence that is aligned with national law and best practice;
- Integrate provisions related to GBV in the employees' CoC;
- The Contractor shall require his employees, sub-contractors, sub-consultants, and any personnel thereof engaged in construction works to individually sign and comply with a Code of Conduct with specific provisions on protection from GBV;
- The contractor will implement provisions that ensure that GBV at the community level is not triggered by the Project;
- The contractor shall develop a specific plan for mitigating these known risks, e.g. sensitization around gender-equitable approaches to compensation and employment; etc
- The contractor will ensure adequate referral mechanisms are in place should a case of GBV at the community level is reported related to project implementation.
- Gender sensitization of workers
- The Contractor shall be required, under its contract, to prepare and enforce a No Sexual Harassment and Non-Discrimination Policy, in accordance with national law where applicable.
- The Contractor should popularize /put in place safe, ethical and confidential mechanisms and hotlines for reporting SEA/SH/GBV cases.
- The Contractor shall observe labour requirements to safeguard the exploitation of children
- Strategies such as male involvement shall be employed in preventing and responding to GBV/SEA and sexual harassment.
- The Contractor should establish partnerships with relevant government agencies, GBV Service Providers and NGOs to ensure survivors of GBV and sexual offences access survivor centred services such as medical care, psychosocial support, legal redress, safety, etc as and when necessary.
- The Contractor should provide gender disaggregated facilities - separate bathing, changing, sanitation facilities for men and women.
- The Contractor should ensure there is a Grievance Redress Mechanisms that has specific procedures for GBV including confidential reporting with safe, and ethical documenting of GBV cases shall be set up for the workers and community.

7.4.20.5 Significance of Impact

The impacts can cause long term effects to the women and children if mitigation measures are not implemented hence the impact magnitude shall remain medium-high. However, if mitigation measures are implemented the impact magnitude shall be low and the impact significance shall remain low

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Gender Based Violence	Without Mitigation	Long Term	Local	High	Medium-High	Medium	Medium-High
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.4.21 Security Risk

7.4.21.1 Baseline Status

The site is an open ground and not fenced. There are no street lights along the service road leading to the site. Most facilities in the area are fenced off with boundary walls and manned by private security companies.

7.4.21.2 Impact Assessment

The Contractor will mobilize expensive machinery and equipment to the project site. The machinery and materials may attract thieves, Employee misconduct in the host communities can also occur. The project may not be able to absorb all the migrant workers looking for job opportunities resulting into animosity and security risk to project workers and property.

Table 64: Impact of Security Risks

Impact	**Impact of Security Risks**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered Medium-High due to the fact that the site is located along a major road and there will be expensive machinery and equipment brought in by the contractor				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered Medium-High due to the fact that the site is located along major road and there will be expensive machinery and equipment brought in by the contractor				

7.4.21.3Mitigation Measures

The mitigation measures to minimise the potential impacts on security risk include:

- The Contractor should prepare Security Risk Management Plan
- Contractor should recruit qualified security coordinator to coordinate and manage security risks
- The Contractors camp containing equipment and machinery is going to be securely fenced off.
- The Contractor's team should work with security agencies to provide security within the site in addition to the Contractor's own security.

- Any employee who persists in any misconduct or lack of care, carries out duties incompetently or negligently, fails to conform to any provisions of the contract, or persists in any conduct which is prejudicial to safety, health, or the protection of the environment shall be removed.
- All reasonable precautions should be taken to prevent unlawful, riotous or disorderly conduct by or amongst the contractor's personnel, and to preserve peace and protection of persons and property on and near the site.
- Alcohol, drugs, arms, and ammunition on the worksite among personnel will be prohibited.
- The contractor and Project Supervisor shall register in a log all events of a criminal nature that occur at the worksite or are associated with the civil works activities.
- The contractor and Project Supervisor shall report all activities of a criminal nature on the worksite or by the contractor's employees (whether on or off the worksite) to the police and undertake the necessary follow-up. Crime reports shall include nature of the offense, location, date, time, and all other pertinent details.
- The Contractor shall ensure that all of his staff sign a written code of conduct to govern employee behaviour on/off site.
- The Contractor should consider installing and making use of CCTV cameras to monitor security within the site. In collaboration with the national police on security matters, the Contractor shall place alarms around the project and establish emergency preparedness and response procedures (EPRP).
- Security agencies providing armed security to the project shall sign Codes of Conduct aligned to the International Good Practices including the World Bank Good Practice Note on Assessing and Managing the Risks and Impacts of the Use of Security Personnel.
  In compliance with the requirements of IFC PS4, paragraph 12, when hiring of security personnel, the contractor shall ensure the following is fulfilled:
  - ✓ Assess risks posed by its security arrangements to those within and outside the project site
  - ✓ In the process of hiring security personnel the Contractor shall be guided by the principles of proportionality and good international practice3 in relation to hiring, rules of conduct, training, equipping, and monitoring of such workers, and by applicable law
  - ✓ The Contractor shall make reasonable inquiries to ensure that those providing security are not implicated in past abuses; they will be adequately trained in the use of force (and where applicable, firearms), and the security personnel will have appropriate conduct toward workers and Affected Communities; and they will be expected to act within the applicable Law of Kenya
  - ✓ The Contractor shall not sanction any use of force except when used for preventive and defensive purposes in proportion to the nature and extent of the threat.
  - ✓ The Contractor will provide a grievance mechanism for Affected Communities to express concerns about the security arrangements and acts of security personnel.

7.4.21.4. Significance of Impact

The mitigation measures provided are intended to eliminate/minimise impacts on security issues arising from the project. If the mitigation measures are not implemented, the magnitude of impact would remain Medium-High. However, with the proposed mitigation measures in place, the impact on project operations would be significantly reduced and the impact significance would be reduced to low. It is therefore important that the proposed mitigations are implemented by the Contractor.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Security Risk	Without Mitigation	Short Term	Regional	High	Medium-High	Medium	Medium-High
	With Mitigation	Short Term	Regional	Low	Low	Low	Low

7.4.22 Risk of Child Exploitation

7.4.22.1 Baseline Status on Child Labour

Here in Kenya, data from the Kenya National Bureau of Statistics (KNBS) shows that 8.5 percent of children, or 1.3 million, are engaged in child labour. The highest child labour rates, at more than 30 percent, are in the arid and semi-arid land (ASAL) counties. Due to the Covid 19 impact, in April 2020, KNBS reported that around 1.72 million people in Kenya had lost their jobs since the start of the pandemic. With this significant loss of income, a growing number of families may resort to sending their children to work.

7.4.22.2 Impact Assessment of Child Labour

Employment Act 2007, Section 56. Prohibition of employment of children between thirteen years and sixteen years of age

1. No person shall employ a child who has not attained the age of thirteen years whether gainfully or otherwise in any undertaking.
2. A child of between thirteen years of age and sixteen years of age may be employed to perform light work which is—
   a) not likely to be harmful to the child's health or development; and
   b) not such as to prejudice the child's attendance at school, his participation in vocational orientation or training programmes approved by the Cabinet Secretary or his capacity to benefit from the instructions received.

Children Act 2001 Section 10. Protection from child labour and armed conflict

(1) Every child shall be protected from economic exploitation and any work that is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral or social development.

The Contractor will be required to observe the requirements of these Acts when recruiting workers in the project.

Table 65: Risk of Child Exploitation

Impact	Risk of Child Exploitation				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated

Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered Low since awareness of the law requirements is much better among urban residents				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered Low since awareness of the law requirements is much better among urban residents				

7.4.22.3Mitigation Measures

The mitigation measures to minimise the potential impacts on child labour from construction activities include:

- Provide and implement a Child Protection Strategy.
- Ensure no children are employed on site in accordance with Children Act, 2001.
- Carry out proper age verification before engaging anyone for a job at the plant
- Ensure that any child sexual relations offenses among contractors' workers are promptly reported to the Authorities
- Carry out workers and Community sensitization on child protection, requirements of Children Act, 2001 and eradication of child labour.

7.4.22.4Significance of Impact

The impacts can cause long term effects to the children if mitigation measures are not implemented However, vigilance is much better in urban areas hence impact significance is considered low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Child Labour	Without Mitigation	Short Term	Local	Low	Low	Low	Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.5 Environmental Impacts and Mitigation Measures – Operation Phase

7.5.1 Impact of Bird Collisions with Solar Panel and Light Pollution

7.5.1.1 Background on Bird Collision Risk and Disorientation

Like glass or reflective surfaces on buildings, PV panels could present a collision risk to birds especially if the surfaces are vertically oriented or reflecting light.

7.5.1.2 Impact Assessment

Bird Collision with Solar Panels

Like glass or reflective surfaces on buildings, PV panels could present a collision risk to birds especially if the surfaces are vertically oriented or reflecting light. Bird may crash onto the panels since they mistake the flat surfaces of PV panels for water bodies and attempt to land on them – the 'lake effect' This can risk injury and be detrimental to certain birds that cannot take off without a water body (Horváth et al. (2009); Huso et al. (2016).).

Light Pollution

Placing flood light in the middle of an isolated area might disorient nocturnal migratory birds which may follow the light as cue for navigation in the same way they use stars, moon, the sun etc.

Table 66: Bird Collision with Solar Panel and Flood Light Effect

Impact	**Impact on Bird Collision with Solar Panel and Flood Light Effect**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
	The impact severity is medium since species of birds that collide with panels are found in the area					
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is medium-high since species of birds that collide with panel are found in the area					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The impact significance is medium-high since species of birds that collide with panels are found in the area					

7.5.1.3 Mitigation Measures

Bird Collision with Solar Panels

- Maintain visible corridors between sets of panels
- Keep panels as horizontal as possible

Light Pollution

The mitigation measures to minimise the potential impacts on birds include:

- Placing flood light in the middle of an isolated area might disorient nocturnal migratory birds which may follow the light as cue for navigation in the same way they use stars, moon, the sun etc.

7.5.1.4 Significance of Impact

During operations, there will be impacts arising from birds mistaking panels for water and colliding with them Birds will also be affected by too much light.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact on Fauna (Birds)	Without Mitigation	Long Term	Local	Medium	Medium-High	Medium	Medium-High
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.5.2 Impact on Fauna (Reptiles and Amphibians) During Operation

7.5.2.1 Reptiles s and Amphibians at the Project Site

A total of 23 species were observed in Bamburi Cement, Athi River proposed solar farm. See Annex 4. They included six amphibians, eight lizards, eight snakes and one tortoise (see Figure 5). Most of the species were observed in backfilled areas where vegetation regeneration has started. The most dominant species was Red headed rock agama which virtually occurred everywhere including fresh dumping sites. This demonstrates the human disturbance tolerance level certain species are able to cope with.

7.5.2.2 Impact Assessment

- Shaded areas under the panel grids may become potential resting areas for reptiles in hot sun during the day or perhaps turning into long-term preferred habitats despite potential risks including electro-magnetic radiations.
- Species such as amphibians are known to occupy both aquatic and terrestrial environments alternately – e.g., for foraging and breeding in wetlands at night and retreating to the riparian bushes by day. Development infrastructure like solar farms may split an expected continuum for such movement thereby interfering with an entire population.
- Amphibians are particularly sensitive to changes to the environment due to their sensitive skin structure. Any changes such as pollutants in aquatic environments are known to cause mass die offs and impacts on potential breeding sites.

Table 67: Fauna (Reptiles and Amphibians)

Impact	**Impact on Fauna (Reptiles and Amphibians)**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is low since the site is already disturbed				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain

Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is medium-low since habitat for reptiles and amphibians is already disturbed					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The impact significance is medium-low since habitat for reptiles and amphibians is already disturbed					

7.5.2.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on herpetofauna include:

- Design for the project to consider including buffer zones between solar panel arrays.
- Reduce the use of heavy machinery where possible.
- Water sprinkling during construction; Proper disposal of all waste matter emanating from the site.
- Reptiles and amphibians are expected to move between habitats. The fence type should include under-passes that allow movement of crawling animals.

7.5.2.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the reptiles and amphibians existing at the project site. If the mitigation measures are not implemented, the impact magnitude would be medium-low. However, with the proposed mitigation measures in place, the impact on herpetofauna would be significantly reduced and the impact significance would be reduced to low. It is therefore important that the proposed mitigations are implemented to ensure the fauna at the site are protected.

Impacts	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impacts on Fauna Reptiles and Amphibians	Without Mitigation	Long Term	Local	Low	Medium-Low	Medium	Medium-Low
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.5.3 Impact on Herpetofauna During Operation

7.5.3.1 Reptiles s and Amphibians at the Project Site

A total of 23 species were observed at the Athi River proposed solar farm site. See Annex 4. They included six amphibians, eight lizards, eight snakes and one tortoise Most of the species were observed in backfilled areas where vegetation regeneration has started. The most dominant species was the Red headed rock agama which virtually occurred everywhere including fresh dumping sites. This demonstrates the human disturbance tolerance level certain species are able to cope with.

7.5.3.2 Impact Assessment

Reptiles and amphibians are sensitive to habitat alteration as a result of removal of vegetation for solar PV plant installation. Subsequently, species loss due to deaths may occur.

Hence changes occurring during construction are known to have direct impacts on species microhabitats like burrows, tree backs, stones and other objects used as resting or nesting areas for reptiles and amphibians. During clearance of vegetation and soil leveling slow crawling and slow-moving animals especially invertebrates may be adversely affected. These animals tend to have small home ranges, and are unlikely to escape quickly in avoiding dangers accessioned by machines clearing vegetation or digging soils.

Table 68: Fauna (Reptiles and Amphibians)

Impact	**Impact on Fauna (Reptiles and Amphibians) During Construction**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is medium since reptiles and amphibians will be losing their habitat				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is medium-low since the herpetofauna existing within the site will need to be given a chance to migrate to the neighbouring habitat					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact magnitude is medium-low since the herpetofauna existing within the site will need to be given a chance to migrate to the neighbouring habitat				

7.5.3.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on herpetofauna include:

- Reduce the use of heavy machinery where possible.
- Water sprinkling during construction; Proper disposal of all waste matter emanating from the site.
- Reptiles and amphibians are expected to move between habitats. The fence type should include under-passes that allow movement of crawling animals

7.5.3.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the reptiles and amphibians existing at the project site. If the mitigation measures are not implemented, the impact magnitude would be medium-low. However, with the proposed mitigation measures in place, the impact on herpetofauna would be significantly reduced and the impact significance would be reduced to low. It is therefore important that the proposed mitigations are implemented to ensure the reptiles and amphibians at the site are protected.

Impacts	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impacts on Fauna Reptiles and Amphibians	Without Mitigation	Long Term	Local	Medium	Medium-low	Medium	Medium-low
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.5.4 Impacts on Invertebrates During Construction

7.5.4.1 Invertebrates at the Project Site Area

A total of 128 species were recorded from 19 orders. See Annex 5. These was from a sample size of 891 invertebrate specimens collected. Wasps and ants (hymenoptera) were the most collected group of invertebrates followed by flies (Diptera) and beetles (Coleoptera) (Fig 6). Common species seen around the site included the butterflies from the Pieridae family, different beetle species, earwigs, spiders, snail shells, isopods, crickets, millipedes and cockroaches. Wolf Spider (Lycosidae) and black and yellow leaf chafer beetle (*Pachnoda sp*) were also common from general search and BBT collections respectively (Plate 21). Baited butterfly traps, general search and yellow pan trap had the highest specimen abundance.

7.5.4.2 Impact Assessment

Lake Effect - Solar panels are potential ecological traps for invertebrates due to the 'lake effect' caused by their reflective surfaces. Aquatic invertebrates are attracted to the panels on which they may lay eggs thus reducing their productivity.

Insect Attraction to Panels: Insect attraction to the panels may increases their population in the solar farms leading to attraction of insectivorous birds – which may in turn be detrimentally affected e.g., collision with the panels or burn up through solar flux.

Creation of Invertebrate Microhabitats: The installation of solar panels can also cause effects in the environment by creation run-offs or sun shadows. This leads to invertebrate assemblages as habitat patches are created

Table 69: Impacts on Fauna (Invertebrates)

Impact	**Impact on Fauna (Invertebrates) During Operation**				
Impact Nature	Positive	Negative	Neutral		
Impact Type	Direct	Indirect			
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is considered low since invertebrates will continue thriving in the new environment with solar panels				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain

Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered low since the invertebrates will be site will continues thriving undisturbed in the project site					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The impact significance is considered low since the invertebrates will continue thriving undisturbed					

7.5.4.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on herpetofauna include:

- Use of white boarder or grids to break the polarized solar panel surfaces in order to reduce water invertebrate egg laying behaviours
- Use of anti-reflective coatings (ARCs) to reduce the amount of polarized light pollution that they reflect, and hence their attractiveness to insects (Száz et al., 2016).
- Ensuring there is a good drainage system to avoid collection of water that may cause invertebrate assemblages
- Ensuring there is a good drainage system to avoid collection of water leading in places that may cause invertebrate assemblages

7.5.4.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the invertebrates existing at the project site.. If the mitigations are implemented invertebrates will continue to thrive and the impact significance remains low.

Impacts	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impacts on Invertebrates	Without Mitigation	Long Term	Local	low	Low	Low	Low
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.5.5 Water Resources for Operation of the Solar Plant

7.5.5.1 Baseline Status

The land is disused albeit for stockpiles.

7.5.5.2 Impact Assessment

The installation and operation activities of the solar farm will require a significant quantity of water. A modest quantity of water will be required during construction however, much more will be required during the operations. Water requirement for construction activities will be determined after finalization of the detail design. It is estimated that during operation. each event of cleaning the 7,938 modules will be approx. 15,876 litres of water assuming each module requires approx. 2 litres.

Depending on the level of dust in the project area, cleaning may be required as often as every month escalating the water demand to 190,512 litres. Since there is no piped water supply, the Contractor will need to source for an independent water supply for the project. A dedicated source of water will therefore be needed since the project area is water stressed and the available option is sinking a borehole.

Table 70: Water Resources for Solar Plant

Impact	**Impact on Water Resources for Solar Plant**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The significance of impact is considered High due to the large volume of water that will be required during the operation period					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The significance of impact is considered High due to the large volume of water that will be required during the operation phase					

7.5.5.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on the water resources for construction activities include:

- A dedicated source of water supply shall be sought to avoid interfering with the local supply.
- Assuming that the borehole water quality meets the requirement, developer to consider having a dedicated borehole drilled for the project. Boreholes within the project area have good yields that range from 4-45m^3/hour.
- Workers shall be trained on economical use of available water resources for operations.

7.5.5.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the water resources. If the mitigation measures are not implemented, the magnitude of impact would remain Medium-High. However, with the proposed mitigation measures in place, the impact to the ecosystem and project operations would be significantly reduced and the impact significance would be reduced to low. It is therefore important that the proposed mitigations are implemented.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Water Resources	Without Mitigation	Short Term	Local	Medium	Medium-High	Medium	Medium-High
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.5.6 Increased Surface Run off

7.5.6.1 Site Baseline Status

The site topography is gently sloping southwards. The solar panels will form a broad surface that will collect rain and release it to the ground as storm water in between the panels. To be evacuated through the drains that have been provided at the site.

7.5.6.2 Impact Assessment

The solar panels may lead to increased volume and velocity of storm water or run-off flowing across the area covered by the panels. This may lead to increased amounts of storm water entering the drainage systems, resulting in overflow and damage to such systems in addition to increased erosion or water logging in the area. The increased run-off may lead to soil erosion in the areas where the water drains off to or drainage blockages.

Table 71: Increased Surface Run-Off

Impact	**Increased Surface Run-Off**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-low since Athi River area receives significant amount of rainfall of about 1250mm annually with the heavy rainfall occurring between the months of March and May.					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The impact magnitude is considered medium-low since Athi River area receives significant amount of rainfall of about 1250mm annually with the heavy rainfall occurring between the months of March and May..					

Mitigation measures

- Using materials that mimic natural percolation of water.
- Identify and grow grass that will withstand storm water.
- Constructing proper drains and regular inspections and monitoring them to ensure there are no blockages.
- Drainage channels should be installed in all areas that generate and receive runoff.
- The channels should be covered with gratings or other suitable and approved materials to prevent occurrence of accidents and dirt entry that may compromise flow of run-off.
- Create embankments to reduce runoff speed and re- vegetate the area to increase water infiltration into the soil.
- The proponent will ensure that there are adequate means for handling the small quantities of storm water to be collected from the solar arrays.
- Create a well-planned drainage system by allowing growth of grass for diverting storm water runoff.

7.5.6.1 Significance of Impact

The mitigation measures provided are intended to reduce impacts on the drainage pattern. If no mitigation is carried out the impact magnitude would be medium-low however if mitigation is implemented then the impact significance would be low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Increased Surface Run-Off	Without Mitigation	Long-Term	Local	Medium	Medium-Low	Low	Medium-Low
	With Mitigation	Long-Term	Local	Low	Low	Low	Low

7.5.7 Occupational Health and Safety Risks

The project workers will be exposed to occupational risks due to working at heights while cleaning the panels and carrying out maintenance. Sometimes the high temperatures in the project area will expose the workers to difficult working conditions including the temptation to remove safety gear while working in areas that require such safety precaution. The reflection from the surfaces of the panels will provide a heavy glare on the workers. Possibility of snakes from the maintained ecosystem migrating to the area with panels where workers operate.

7.5.7.1 Sources of Occupational Health and Safety Risks

The sources of impact on the health and safety of workers at the solar plant will arise from the following construction activities:

- Exposure to risk of falling when working at elevated positions
- Heavy glare from the solar panel surfaces,
- Electric shocks for the workers carrying out maintenance,
- Presence of snakes

Receptors

The receptors of occupational safety and health impacts are workers both temporary and long term. The level of exposure to risk will vary from one task to another requiring that the seriousness of mitigations also varies with the level of risk.

7.5.7.2 Impact Assessment of Occupational Health and Safety Risks

Arising from the above-mentioned activities that will take place during operation, the workers and other personnel at the solar plant will be exposed to impacts as follows:

- Risk of falling from working at heights
- Eye problems arising from glare from the solar panels
- Possibility of getting snake bites
- Heat stress arising from working under hot weather

The exposures could cause long term impacts if mitigation measures are not implemented hence the severity of impact has been assessed to be medium. However, if mitigation measures are implemented as proposed then the impact significance will be medium high.

Table 72: Generation, Storage and Disposal of Solid and Liquid Waste

Impact	**Generation, Storage and Disposal of Solid and Liquid Waste**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The magnitude impact is considered Medium-High due to high chance of injury occurring				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The significance of impact is considered Medium-High due to high chance of injury occurring				

7.5.7.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on the occupational safety and health risk from construction activities include:

- Momnai Energy and the Operations Contractor should prepare a detailed Occupational Safety and Health Management Plan (OSHMP) that will provide all the required health and safety measures to safeguard the workers during operation.
- Momnai Energy and the Operations Contractor should prepare an Emergency Response Plan
- Momnai Energy and the Operations Contractor should prepare a Code of Conduct that inter alia commits to the Implementation of the OSHMP and that also commits at individual level to compliance with OSHMP requirements and standards.
- Momnai Energy and the Operations Contractor should induct and train all operations workers on OHS, Fire Response and Emergency procedures
- Hold weekly (or as appropriate) tool box meetings for all workers

- Provide workers with appropriate personal protective equipment (PPE) and instil a mechanism to ensure appropriate usage; The PPE should include anti-glare glasses and Harnesses for working at heights
- Provide workers with adequate portable drinking water.
- Provide clean and adequate toilets for workers, these toilets will be to World Health Organisation standards

7.5.7.4 Significance of Impact

The impacts can cause long term impacts to the health and safety of the construction workers hence the severity of the project is considered medium, however if mitigations are implemented, then the magnitude of impact would be low and the impact significance would also be low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Occupational Health and Safety Risks – Operation Phase	Without Mitigation	Short Term	Project Site	Medium	Medium-High	Medium-High	Medium-High
	With Mitigation	Short Term	Project Site	Low	Low	Low	Low

7.5.8 Species Influx into the Modified Habitats

7.5.8.1 Status of Modified Habitat and Impacts

Shaded areas under the panel grids may become potential resting areas for reptiles in hot sun during the day or perhaps turning into long-term preferred habitats despite potential risks including electro-magnetic radiations or potential danger from snakes to humans.

Presence of drainage water and habitable vegetation by smaller fauna like insects, rats, frogs, insects etc., may in turn attract predatory birds, which may then be detrimentally affected e.g., collision with the panels.

Table 73: Species Influx into Modified Habitats

Impact	**Impact of Species Influx into Modified Habitat**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
	The impact severity is medium since the induced movement will create impacts					
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High

	The impact magnitude is considered medium-high since there will be high chance of fauna migrating to the modified habitat where the solar panels are located				
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is medium-high since there will be a high chance of fauna migrating to the modified habitat where the solar panels are located.				

7.5.8.2 Mitigation Measures

To minimise species influx to the modified habitats the following mitigations need to be implemented"

- Clear any vegetation that may attract fauna under or around the panels
- Ensure there is a good drainage system to avoid collection of water pools that may attract aquatic macro-invertebrate and frog assemblages

7.5.8.3 Significance of Impact

During operations, there will be impacts arising from the induced migration of fauna from the wetlands to the area where the panels are providing shade. This will have the potential to attract predators that may get injured or killed by the solar plant infrastructure. Therefore, the impact magnitude remains medium-high if mitigations are not implemented. However, mitigations are put in place then the impact magnitude will be low and impact significance becomes low. The proposed mitigation measures are therefore important and need to be heeded to minimise the impacts.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Species influx to modified to Modified Habitat	Without Mitigation	Long Term	Local	Medium	Medium-High	Medium	Medium-High
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.5.9 Impact of Lake Effect and Solar PV Heat Island Impacts

7.5.9.1 Lake Effect and Heat Island Occurrence

Lake Effect on Birds and Invertebrates

Birds may crash onto the panels since they mistake the large flat and reflective surfaces of PV panels for water bodies and attempt to land on them – the '*lake effect'*. This can risk injury and be detrimental to certain birds that cannot take off without a water body (Horváth et al. 2009, Huso et al. 2016). Similarly, solar panels are potential ecological traps for invertebrates. Aquatic invertebrates are attracted to the panels on which they may unsuccessfully attempt to lay eggs thus reducing their productivity.

Heat Island Effect on Birds and Invertebrates

Large scale solar farms may potentially cause an increase in local ambient temperature and thus changing the microclimate in the area where the vegetation and terrain have been altered – the so-called solar PV "heat Island" effect (PVHI, Barron-Gafford et al 2016). This may render the project proximity environment warmer hence unsuitable for some sensitive species such as amphibians which may be pushed further off the project area. However, areas with natural vegetation help reduce ambient temperatures (Barron-Gafford et al 2016), hence PVHI effect could be mitigated through targeted revegetation and retention of natural vegetation in the area (Hernandez et al 2014).

This synergistically supports biodiversity, ease ecosystem degradation associated with the solar plant, while enhancing the collective ecosystem services associated with the area (Hernandez et al 2014).

Table 74: Lake Effect and Heat Island Impacts

Impact	Impact of Lake Effect and Heat Island Impacts				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is medium since species of water birds that may be affected exist in the project area. Amphibians that may also be affected by heat island effect exist within the project area				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is medium-high since species of birds that collide with panel are found in the area. Amphibians are also impacted by heat island effects					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is medium-high since species of birds that collide with panel are found in the area. Amphibians are also impacted by heat island effects				

7.5.9.2 Mitigation Measures

Lake Effect on Birds and Invertebrates

- Maintain visible corridors between sets of panels
- Use of white boarder or grids to break the polarized solar panel surfaces in order to reduce water invertebrate egg laying behaviours
- Use of anti-reflective coatings (ARCs) to reduce the amount of polarized light pollution that they reflect, and hence their attractiveness to insects (Száz et al., 2016).

7.5.9.3 Solar PV Heat Island Effect

- Ensure that existing forest patches are maintained and well conserved to help absorb heat emanating for the PV panels, hence mitigate PVHI effect
- Protect and conserve neighboring forest galleries and natural thickets to help absorb heat emanating for the PV panels, hence mitigate PVHI effect
- Establish a tree nursery and conduct targeted revegetation and grow trees in certain areas near or within the project area to help absorb heat emanating for the PV panels, hence mitigate PVHI effect.

7.5.9.4 Significance of Impact

During operations, there will be impacts arising from birds mistaking panels for water and colliding with them. Amphibians will also be impacted by heat island effect from the panels. If mitigations are not implemented impact magnitude will be medium-high. However, with mitigations, the impact significance will be low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Impact on Fauna (Birds)	Without Mitigation	Long Term	Local	Medium	Medium-High	Medium	Medium-High
	With Mitigation	Long Term	Local	Low	Low	Low	Low

7.6 Environmental Impacts and Mitigation Measures – Decommissioning Phase

Decommissioning activities shall be preceded by preparation and submission of a detailed Decommissioning Plan to NEMA and County Government 30 days prior to the date of execution for permission to proceed be granted. It should be noted that some decommissioning activities will be carried out before the end of the lifespan of the project. This may include material source sites like:

- Borrow Pits and Quarries if they have been used to provide materials for the project
- Construction Camp for the contractor

Decommissioning of such sites should proceed as soon as their use comes to an end to avoid escalation of safety risks.

7.6.1 Occupational Health and Safety Risks

Risk of Respiratory Illnesses due to Air Pollution Inhalation of fumes, dust from decommissioning activities may lead to respiratory infections. Fire risks and electrocution may occur from electrical cables. Electronic equipment may also contain hazardous material harmful to human health.

7.6.1.1 Sources of Occupational Health and Safety Risks

The sources of impact on the health and safety of workers at the solar plant will arise from the following construction activities:

- Dismantling of structures
- Removal of solar panels,
- Removal of electrical cables, inverters and transformers,
- Demolition of housing structures
- Excavation and removal structure bases
- Levelling of the ground and restoration.

Receptors

The receptors of occupational safety and health impacts are workers both temporary and employees.

The exposure.

The level of exposure to risk will vary from one task to another requiring that the seriousness of mitigations also varies with the level of risk.

7.6.1.2 Impact Assessment of Occupational Health and Safety Risks

Arising from the above-mentioned activities that will take place during decommissioning, the workers and other personnel at the solar plant will be exposed to impacts as follows:

- Injuries associated with operation of machinery
- Injuries arising from loading, unloading and lifting heavy materials
- Health impacts arising from being exposed to fugitive dust and exhaust emissions
- Potential injury from a fall due to working at heights
- Impacts from exposure to excessive noise
- Injury from slips and fall
- Overexertion injuries/illnesses
- Fire due to hot works, failure in electrical installations
- Injury from project vehicle accidents
- Heat stress arising from working under hot weather

The exposures could cause long term impacts if mitigation measures are not implemented hence the severity of impact has been assessed to be high. However, if mitigation measures are implemented as proposed then the impact significance will be medium high.

Table 75: Occupational Health and Safety Risks

Impact	**Occupational Health and Safety Risks**					
Impact Nature	Positive		Negative		Neutral	
Impact Type	Direct			Indirect		
Impact Severity	Insignificant	Low	Medium	High	Very High	
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated	
Impact Extent	Project Site	Local	Regional	National	Trans Boundary	
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain	
Potential for Irreplaceable loss of resource	Low		Medium		High	
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The magnitude impact is considered Medium-High due to high chance of injury occurring					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High	
	The significance of impact is considered High due to high chance of injury occurring					

7.6.1.3 Mitigation Measures

The mitigation measures to minimise the potential impacts on the ecology from construction activities include:

- Prepare a detailed Occupational Safety and Health Management Plan (OSHMP) that will provide all the required health and safety measures to safeguard the workers.
- Prepare a Code of Conduct that inter alia commits to the Implementation of the OSHMP and that also commits at individual level to compliance to OSHMP requirements and standards.

- Carry out work assessment and identify hazardous substances and working conditions and include safety measures in the OSHMP
- Ensure that all machines and equipment are in good working conditions and to manufacturer's specifications to prevent occupational hazards.
- Appoint qualified full-time health and safety advisor and fire marshal on-site for the duration of the demolition work.
- Establish Health and Safety committee and provide first aid kits and train first aiders
- Induct and train all construction workers on OHS procedures
- Hold daily (or as appropriate) tool box meetings for all workers
- Provide workers with appropriate personal protective equipment (PPE) and instil a mechanism to ensure appropriate usage;
- Adequate training should be provided to staff on use of Personal Protection Equipment (PPE) and emergency response measures;
- Provide workers with adequate portable drinking water and breaks.
- Train workers on safety procedures/emergency response such as fire, oil and chemical spills.
- Ensure that water is sprayed in dust areas to suppress fugitive dust.
- Contractor to provide an ambulance vehicle to evacuate for emergency situations
- Prepare Emergency Response Plan
- Fence off the site with security to avoid unauthorized access to the site
- Provide clean and adequate toilets for workers, these toilets will be to World Health Organisation standards

7.6.1.4 Significance of Impact

The impacts can cause long term impacts to the health and safety of the workers hence the severity of the project is considered medium, however if mitigations are implemented, then the magnitude of impact would be low and the impact significance would also be low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Occupational Health and Safety Risks during Demolitions	Without Mitigation	Short Term	Local	Medium	Medium-High	High	Medium-High
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.6.2 Generation, and Disposal of Solid and Liquid Waste

7.6.2.1 Sources of Solid and Liquid Wastes

The solar power plant will have the following sources of waste for decommissioning:
- The solar plant infrastructure
- Solar Panels
- Electrical cables, inverters and transformers
- Buildings
- Fencing materials etc.

Receptors
The above wastes generated from demolition of the above items if not well managed may Impact on the site soil, surface water (the sensitive swamp at the site including the flora and fauna) and air.

7.6.2.2 Impact Assessment

The items to be decommissioned and demolished may contain chemicals and other hazardous contents therefore handling requires care. Demission activities shall strictly follow the decommissioning plan

The items to be demolished contain metals, bricks etc while others will be at elevations of more than 2m Appropriate PPE shall be used.

Table 76: Generation, Storage and Disposal of Solid and Liquid Waste

Impact	**Generation, Storage and Disposal of Solid and Liquid Waste**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact magnitude is considered medium-low since the activities do not directly impact the resources					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered medium-low since the activities do not directly impact the resources				

7.6.2.3 Mitigation Measures

Due to the presence of sensitive receptors within the site and also presence of community settlements and public institutions less than 400m away from the site, management of the solid and liquid wastes becomes critical.

- The Decommissioning Contractor shall prepare for use an elaborate Decommissioning Management Plan;
- The Decommissioning Contractor shall also prepare an elaborate Hazardous Waste Management Plan
- The Decommissioning Contractor shall ensure that an emergency response plan for preventing and dealing with emergencies like oil spills is put in place.
- The nearest local authority can be contracted to take the responsibility of disposing sewerage waste from the site.
- If septic tanks are used for the management of sewerage waste at the site, then then the authorities shall evacuate them before demolition

- Recovered waste debris and excavated material will be stored in a confined area to prevent spread by wind or water;
- Used or waste oil recovered from generators, vehicles, construction machinery and equipment shall be stored on a paved surface with containment in a secure location at the project site. Appropriate secondary containment capable of containing the 110 percent of the largest tank is to be provided;
- The waste oil and other hydraulic fluids, which is characterized as hazardous shall either be sold to authorized vendors at frequent intervals; or collected by authorised dealers.

7.6.2.4 Significance of Impact

The mitigation measures provided are intended to reduce impacts to the site workers, soil since spillages and leaks of oils, fuels and other chemicals can cause serious pollution during decommissioning phase. If the mitigation measures are not implemented, the impact would remain Medium-Low. However, with the proposed mitigation measures in place, the impact to the ecosystem would be significantly reduced and the impact significance would be reduced to low. It is therefore important to implement the mitigation measures.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Generation, Storage and Disposal of Solid and Liquid Waste during Decommissioning	Without Mitigation	Short Term	Local	Medium	Medium-Low	Medium	Medium-Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.6.3 Emission of Air Pollution During Decommissioning

The site is located in an area occupied by large industries including Poly Tanks, SPA Industries, Exom Industries (PTY) Ltd, Eurostar Industrial Ltd, Ndovu Cement Company and Mombasa Cement Company.

7.6.3.1 Potential Air Pollution During Demolition

During decommissioning and demolition of solar plant infrastructure, there will be two sources of air quality impacts namely fugitive dust and exhaust emissions from vehicles, generators and construction machines.

Fugitive Dust and Exhaust Emissions

The soils of the project area are composed of moderately deep to deep of loam to clays with high gravel content associated with savanna woodland. These reddish soils form fine dust that is easily aroused when the is wind or vehicles passing through the unpaved road passing on the eastern boundary of the site. Fugitive dust will come from earthworks including excavation works, grading, levelling, movement of vehicles across unpaved roads particularly when dry and windy. Movement of trucks and others vehicles when transporting recovered materials and waste will generate fugitive dust and exhaust emissions.

7.6.3.2 Impact Assessment of Fugitive Dust from Demolition Activities

The main demolition activities that will increase air pollution are:

- Breaking and bringing down of site buildings

- Excavation of solar structure bases
- Ground levelling during restoration
- Vehicle movements within and outside the site taking away materials and wastes

Potential Receptors

Majority of the potential receptors of fugitive dust are the workers and the immediate neighbours of the site which include Poly Tanks, SPA Industries, Exom Industries (PTY) Ltd, Eurostar Industrial Ltd, Ndovu Cement Company and Mombasa Cement Company.

Table 77: Fugitive Dust from Construction Activities

Impact	**Fugitive Dust from Construction Activities**				
Impact Nature	Positive		Negative		Neutral
Impact Type	Direct			Indirect	
Impact Severity	Insignificant	Low	Medium	High	Very High
	The impact severity is considered medium since the access road passes close to the neighboring industries				
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low		Medium		High
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
	The impact severity is considered medium since the fugitive dust and exhaust emissions will be limited					
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The impact significance is considered medium since the fugitive dust and exhaust emissions will be limited				

7.6.3.3 Mitigation Measures to Minimise Impact of Fugitive Dust

The following measures shall be put in place to reduce the impacts of fugitive dust:

- The decommissioning Contractor should prepare a Decommissioning Management Plan that contains aspects on Air Pollution.
- A programme shall be put in place to regularly sprinkle water along the road section and inside the site area to suppress dust during the dry season
- Dust level shall be monitored during demolitions and transportation using potable air quality monitors
- Speed of vehicles on site and approach road will be limited to speeds of around 20km/hr. This will help in reducing fugitive dust emission from vehicle movement

- Trucks transporting soil stockpiles shall be totally covered with impervious material to suppress dust during transportation
- Soil stockpiles shall be covered or water sprinkled regularly to minimise fugitive dust emission.
- Workers on dusty at the site shall be issued with appropriate PPE such as, dust masks during dry and windy conditions
- The Decommissioning Contractor shall ensure that education and awareness creatin is done for workers and sensitise on demolition workers and emission reduction techniques

7.6.3.4 Significance of Impact

The mitigation measures provided are intended to minimise impacts as low as possible.. The above-mentioned mitigations can minimise impacts if applied, otherwise the significance of impact will remain medium-low. If the mitigations are applied, then impact significance will be low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Air Pollution during Decommissioning	Without Mitigation	Short Term	Local	Medium	Medium-Low	Medium	Medium-Low
	With Mitigation	Short Term	Local	Low	Low	Low	Low

7.6.4 Noise Impact During Decommissioning

7.6.4.1 Baseline Status

The site is located in an area occupied by large industries including Poly Tanks, SPA Industries, Exom Industries (PTY) Ltd, Eurostar Industrial Ltd, Ndovu Cement Company and Mombasa Cement Company.

Potential Sources of Noise Impact

The demolition activities that will generate noise impacts include:

- Use of machinery to demolish solar plant structures and buildings
- Excavation activities to remove solar plant structure bases
- Transportation of recovered PV modules and mounting structures, construction material, and construction machinery
- Operation of Excavators, Graders, bulldozers, dump trucks, vibrating roller, wheel loader, rock breaker, flatbed trucks, concrete trucks, cranes, forklifts and various four-wheel drive and service vehicles.

Potential Receptors of Noise Impacts

Majority of the potential receptors of fugitive dust are the workers and the immediate neighbours of the site which include Poly Tanks, SPA Industries, Exom Industries (PTY) Ltd, Eurostar Industrial Ltd, Ndovu Cement Company and Mombasa Cement Company.

7.6.4.2 Impact Assessment

During decommissioning demolitions significant noise impact will emanate from the hammering and movement of vehicles within the site and outside.

Table 78: Noise Impacts from Demolition Activities

Impact	Noise Impacts from Demolition Activities				
Impact Nature	Positive	Negative	Neutral		
Impact Type	Direct	Indirect			
Impact Severity	Insignificant	Low	Medium	High	Very High
Impact Duration	Short Term	Medium Term	Long Term	Permanent but mitigated	Permanent But Not Mitigated
Impact Extent	Project Site	Local	Regional	National	Trans Boundary
Likelihood of Occurrence	Unlikely	Low	Medium	High	Certain
Potential for Irreplaceable loss of resource	Low	Medium	High		
Impact Magnitude	Insignificant	Low	Medium Low	Medium High	High	Very High
Impact Significance	Negligible	Low	Medium-Low	Medium-High	High
	The significance of impact is considered Low				

7.6.4.3 Mitigation Measures to Minimise Impacts of Noise Emission

The following mitigation measures shall be implemented to reduce potential noise impacts during the decommissioning phase of the project:

- The Decommissioning Contractor should prepare a Decommissioning Plan that contains noise management requirements.
- There shall be no discretionary use of noisy machinery within 50m of residential areas and near institutions or use of manual labour in these sections
- The Decommissioning Contractor shall consider the noise emission characteristics of equipment when selecting equipment for the project and select the least noisy machine available to perform the specific work (this is a requirement of OSHA 2007);
- Mobile noise sources such as cranes, earth moving equipment shall be routed in such a way that there is minimum disturbance to receptors;
- The Decommissioning Contractor shall restrict the night time vehicle movement through the access road to the site
- Drivers shall only use designated roads;
- The number of equipment operating simultaneously shall be reduced as far as practicable;
- Equipment known to emit noise strongly in one direction shall be orientated so that the noise is directed away from nearby community settlements;
- All loud and sudden noises shall be avoided wherever possible and fixed noise sources shall be located at least 50m away from the site boundary to minimise noises going beyond site boundary;
- The Decommissioning Contractor shall ensure that all workers wear ear muffs and other personal protective gear/equipment when working in noisy sections. Loud noise and vibration level activities shall be performed during the day (i.e., between 8.00 am and 5.00 pm)
- Vehicles and machinery shall be well maintained and not kept idling when not in use.

7.6.4.4 Significance of Impact

The noise emissions will largely take place inside the site and therefore attenuate to manageable levels when going beyond the site boundary. The impact magnitude is considered medium-low and if the mitigation measures are implemented the significance of impact will be very low.

Impact	Scenario	Duration	Extent	Severity	Impact Magnitude	Potential for Irreplaceable loss of resource	Impact Significance
Noise Pollution during Decommissioning	Without Mitigation	Short Term	Local	Medium	Medium-Low	Medium	Low
	With Mitigation	Short Term	Local	Low	Low	Low	Very Low

7.7 Cumulative Impacts

Cumulative impacts come about when a project activity acts together with other activities (other projects or third-party activities) to impact on the same environmental or social resource or receptor.

The IFC defines cumulative impacts as *"impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted".*

There are no potential cumulative impacts that may arise from other projects in the area since no other project is planned for implementation while the TL is ongoing. The impacts that will arise in project area will be associated with the TL.

7.7.1 Identification of Potential Cumulative Impacts

Table 79 provides a summary of the likely potential cumulative impacts that may result from the construction and operation of the proposed TL.

Table 79: Summary of Potential Cumulative Impacts

Environmental Impact	**Potential Cumulative Impacts**	
	Construction Phase	**Operation Phase**
Loss of flora and fauna, proliferation of invasive species	The project area is largely a private land that belongs to Bamburi Cement PLC. Mitigation measures shall be implemented as provided in the ESMP to minimize any impact. The site is significantly modified by human activities The resource sensitivity is assessed to be low	There will be no additional impacts hence the resource sensitivity is assessed to be low Mitigation shall be implemented as provided in the ESMP to minimize impact
Change in Land Use	The land use is changing from a highly disturbed grassed woodland area to industrial use (Solar Plant). The resource sensitivity is assessed to be low	Some of the disturbed areas will be rejuvenated. The resource sensitivity is assessed to be low
Increased Traffic	Potential cumulative impacts are anticipated with use of construction vehicles and heavy machinery during construction. Implementation of mitigations measures including operationalizing traffic management plans will ensure the impact is low. The resource sensitivity is assessed to be low	Given that traffic volumes will reduce. The design and proposed ESMP mitigation measures will ensure the impact is low. The resource sensitivity is therefore assessed to be low

Environmental Impact	Potential Cumulative Impacts	
	Construction Phase	**Operation Phase**
Road Safety	Potential cumulative impacts on road safety are anticipated due to slight increase in traffic. Implementation of road safety awareness initiatives will ensure the impact is low. The resource sensitivity is therefore assessed to be low	Road safety issues are anticipated to be low during operational phase because of low traffic.
Community Health and Safety	The activities involved in the construction of the TL are limited therefore the community health safety risks will be low. ESMP has provided appropriate mitigations. The resource sensitivity is assessed to be low	Since activities that heighten the impacts on Community Health and Safety will be very low during operation, The resource sensitivity is assessed to be low
Visual Impact	The project site is a commercial area with large industries hence the visual impact will not be very significant. ESMP will be implemented to ensure visual impact from project activities is kept low. The resource sensitivity is assessed to be low	The impact from the Solar Panels will be low given that industrial nature of the project area. The visual impact will be low
Water Resources	The amount of water required during construction period will be modest. The resource sensitivity is assessed to be low	The amount of water required during operation period will be significant since the panels have to be cleaned regularly. A dedicated water supply will be made by sinking a borehole. The resource sensitivity is assessed to be low-medium
Air Quality	Since there is no anticipated project that will create additional impact on air quality, the impact from the project will arise during the construction as well as decommissioning phases as a result of the following activities: • Fugitive dust emissions from site clearing, excavation work, material handling etc.; • Fugitive dust emission from traffic movement; • Exhaust emission from operation of machineries like earth movers, trucks; • Point source emission from diesel generator. Greater attention shall be paid to the ESMP outlined and monitoring to ensure the cumulative impact remain minimum. The resource sensitivity is assessed to be low	There will be fewer vehicles in use during operation. The resource sensitivity is assessed to be low
Ambient Noise	The noise impacts associated with the construction of the Solar Plant will be significant be low and largely confined to the construction area. The ESMP provided will keep the impacts to a minimum. The resource sensitivity is assessed to be low-medium	Noise levels during the O&M phase will be negligible and may only arise during the maintenance. The resource sensitivity is assessed to be low
Social Impacts including: • Labour influx, • Crime, • Disruption of services, • Increased conflicts, • Impacts on children, • GBV, sexual exploitation and abuse	Cumulative impacts arising from implementation of the project among others is expected to cause influx of migrant workers into the area seeking for either skilled or unskilled employment. This may pose increased social risks with respect to among others; new cases of HIV/AIDS contraction, Gender Based Violence, drug trafficking, insecurity issues due to presence of 'strangers' (project workers) and other social challenges. The ESMP has provided mitigation measures that shall be implemented to address the vices and keep them to a minimum. The resource sensitivity is assessed to be low	The influx of migrant workers and vices arising from in migrant workers will reduce significantly and therefore impacts during operations will be low. The ESMP has provided mitigation measures to take care of the impacts. The resource sensitivity is assessed to be low.

Environmental Impact	Potential Cumulative Impacts	
	Construction Phase	**Operation Phase**
Economic Impact	Positive cumulative economic Impact will occur during the construction phases of the project since there will be increased local employment benefits. The Local businesses will experience an increased demand for products and services during construction.	Job opportunities will be available for long term employment to maintain the facility. The resource sensitivity is assessed to be low.

8 ENVIRONMENTAL, SOCIAL AND HEALTH MANAGEMENT AND MONITORING PLAN

8.1 Introduction

This ESMP has been developed to be used as tool to manage the environmental and social impacts that the activities of the solar construction activities may generate. It is expected that before construction of the facility commences, the contractor will use the ESMP to generate specific implementation plans for each construction activities. There are certain areas of the construction activities that will generate hazardous wastes, safety risks and adverse impacts to the environment and to the project area communities that will require specific plans that can guide the construction teams that are implementing the project.

8.2 Environmental and Social Management Plans (ESMPs)

8.2.1 Objectives of Establishing ESMP

The objectives of the ESMP include:

- To provide an overview of the environment, health and safety (EHS), socio-economic and cultural heritage policies, standards and legal legislation that the Project is obliged to comply with,
- To monitor the implementation of mitigation measures against potential adverse impacts of construction and operation phases of the project to ensure that they conform and comply with relevant environmental and social policies, guidelines and legislation;
- To assess for emerging non-anticipated adverse environmental and social impacts and implement relevant mitigation measures to maintain them within acceptable levels;
- To maintain best practices in environmental, social health and safety during project construction and operation phases
- To address capacity building needs within staff of the Project Implementor, Supervision Consultant, Contractor and the Government Authority under whose responsibility the project falls.
- To provide guidance on how to manage EHS risks in the construction phase of the Project in compliance with EHS policies, standards and legal regulations and to ensure that Project commitments are fulfilled,
- To determine the roles and responsibilities of the Supervising Team and Contractors to ensure compliance with EHS requirements during the construction phase of the project,
- To ensure that construction activities are properly checked to ensure that the Project is in compliance with EHS policies, standards and legal regulations;
- Ensure reporting systems are developed and streamlined to deliver EHS compliance performance;
- Enabling ongoing development and EHS compliance coverage.

8.2.2 Scope of the ESMPs

The ESMP has been prepared with the aim of defining and meeting the requirements of the project sponsors and local environmental regulations regarding the following aspects:

- Consideration of the Project Phases;
- Identification of Positive and Negative Impacts;
- Mitigation Measures and Enhancement programs;
- Responsible Institutions and Professionals;

- Monitoring programs;
- Consultations;
- Estimated costs;
- Implementation schedules and reporting.

8.2.3 Grievance Management/Redress Mechanism

A Grievance Redress Mechanism GRM shall be establishment to receive and facilitate resolution of complainants (project affected people, local community and workers) concerns and grievances regarding the project's performance during the construction, operation and decommissioning phases of the project. The mechanism should be able to address the concerns and complaints in a timely fashion by using an easy to understand, transparent and effective grievance redress process that is readily accessible to all segments of the project area population including workers and community members.

This GRM has been developed with the intention of providing an effective tool for early identification, evaluation and resolving of grievances during the full cycle of the project. The range of issues that are likely to arise requiring this process include:

- Poor management of construction activities;
- Compensation payment for services rendered or damages to property,
- Failure to fulfil commitments;
- Interference with public utilities;
- Accidents due to inappropriate planning of vehicle movement;
- Conflicts between migrant workers and local communities;
- Disturbance due to excessive noise or other nuisance during construction or operation;
- Unfair treatment of workers or unsafe working conditions;
- Issues related to Gender (GBV, SEA and VAC).

Since a range the range of issues is diverse, the GRM should be comprehensive enough to tackle complaints without any costs and also provide privacy to complainants especially gender issues.

An effective GRM should have the following:

- Identification of personnel (Grievance Officer who will be receiving and recording grievances at the site level);
- Process of evaluating grievances and determining to determine which process to follow;
- Process of making decisions on providing resolutions;
- Notification procedures;
- Timeframes within which issues are to be resolved;
- Procedure for escalation of issues that cannot be resolved at the site level;

8.2.3.1 Publicizing of the GRM

The developed GRM should be publicized to ensure that all stakeholders (workers, community members, contractor, project management etc) are aware of the existence of the GRM and it shall be used to resolve grievances.

8.2.3.2 Grievance Redress Committee

The developer shall facilitate the formation of a Grievance Redress Committee (GRC). This committee shall comprise of the following representatives:

- Administration Officer;
- Site Supervisor;
- Grievance Officer – Responsible for receiving and recording grievances;
- EHS Manager;
- A Representative from the Community.

8.2.3.3 Special Representatives in the Committee

The developer to consider having a special representative in the committee (Female Members) who can deliberate and resolve grievances touching on gender issues like sexual harassment, rape etc)

The Committee shall have the following functions:

- Keep a live register of all grievances lodge by complainants;
- To provide support to affected communities on issues arising from environmental or social impacts;
- To record grievances of the affected community by categorizing and prioritizing them, and providing solutions within a stipulated time period;
- To report to the aggrieved parties regularly and in a timely fashion, developments regarding their grievances and decisions of the GRC.

8.2.3.4 Training of Workshop

The project developer shall hold a training workshop for stakeholders (workers and community members) to educate and sensitise them regarding the operations of the GRM.

8.2.3.5 Receiving and Recording of Grievances

The Grievance Officer shall receive anonymously record the grievance in a grievance form and assess the type of grievance. If it is an issue that resolved immediately then resolution is provided. If it requires deliberation of the GRC then the Grievance Officer shall indicate the timeframe when the complainant should expect the issues to be resolved.

The Grievance form that shall be used to record grievances shall contain the following information:

- Unique Serial number of the complaint;
- Date of receipt of the complaint;
- Particulars of the complainant (Name, Address, Contact details);
- Nature of Complaint (Subject of the complaint, Brief description of the complaint, where the issue occurred and when, suggestion on what the complainant wants done).

8.2.3.6 Monitoring and Reporting

The developer should carry out regular monitoring (monthly) of the records of complaints to establish the effectiveness of the mechanism and whether there are any unresolved issues. The GRC should keep detailed minutes of their deliberations during meetings to resolve grievances. Any issues that the GRC is not able to resolve should be escalated to the Project Management for resolution in a timely manner.

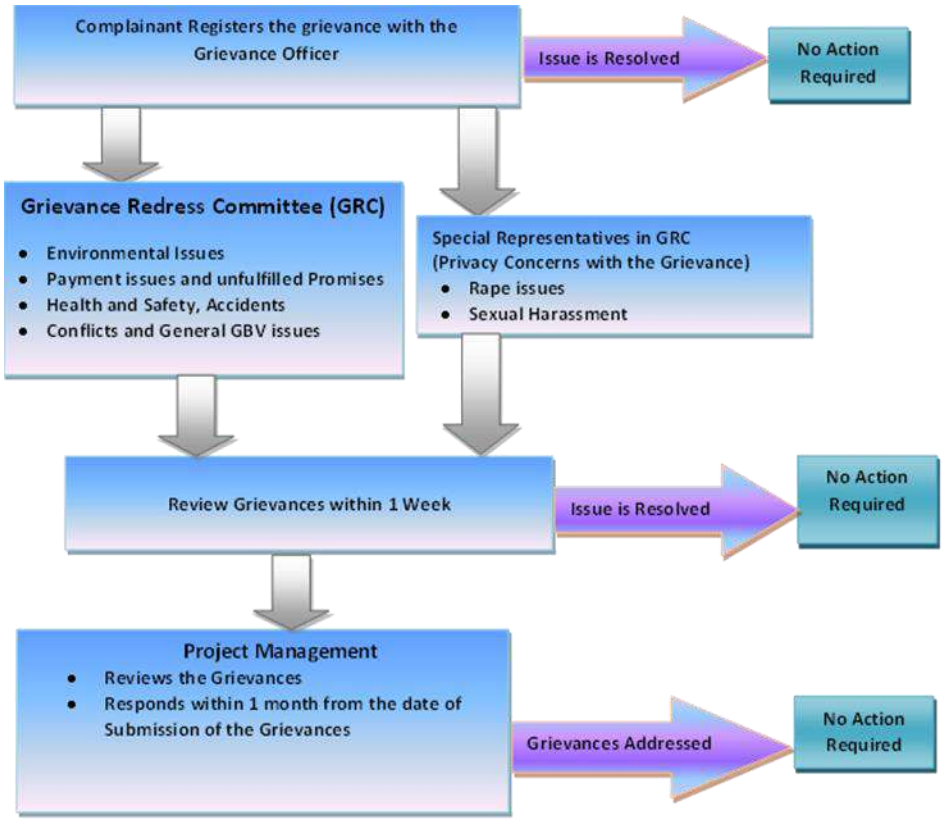


Figure 19: Chart Showing Grievance Redress Mechanism

8.3 Environmental and Social Management Plan during Construction Phase

The impacts, mitigation measures, responsible party, monitoring indicator and allocation of costs pertaining to prevention, reduction and monitoring of significant negative impacts and maximization of positive impacts associated with the construction, operation and decommissioning phases of the proposed project are outlined in **Table 82.**

8.4 Framework for Implementation of the ESMP

The Contractor will be expected to address all aspects of the construction activities in compliance with all laws and regulations, approvals, licenses and permits which are applicable to the proposed Solar project. The Contractor shall ensure that he is familiar with the ESMP for the project. He shall prepare the work plan and strategy taking into account the relevant provisions of the ESMP. The prepared Management plans shall be reviewed and approved by Environment and Social Safeguards Officer of the project implementor.

The Contractor will also be expected to evaluate the construction activities/components and prepare appropriate project implementation management plans including:

1) Construction Environment and Social Management Plan;
2) Waste Management Plan;
3) Hazardous Materials Management Plan;
4) Occupational Safety and Health Plan;
5) Traffic Management Plan;
6) Community Engagement Plan;

7) Child Protection Strategy;
8) Workers Code of Conduct;
9) HIV and AIDS Management Plan;
10) Stakeholder Engagement Plan;
11) Labour Influx Plan;
12) Grievance Redress Mechanism;
13) Employment Plan;
14) Quarry and Borrow Pit Management Plan;
15) Prevention and Protection Against GBV and Sexual Exploitation;
16) Whistle-blower.

8.4.1 Organization Roles and Responsibilities

The Contractor will be expected to engage the following safeguards officers on a full-time basis for the period of the project.

- Grievance Officer (Sociologist);
- EHS Expert (Environmentalist);
- CLO (Client Liaison Officer – Community Representative).

Before commencement of construction process, the Contractor will be expected to show familiarity with the methodology on the implementation of Environmental and Social Safeguards. The above officers will have the responsibility of assisting the Contractor to comply with the safeguard's requirements. Among other duties, the safeguards officers will be responsible for carrying out roles as listed in **Table 80.**

The Safeguards Team will be reporting to the Project Supervisor on Safeguards achievements, issues and challenges on regular basis.

Table 80: Roles of Safeguards Officers Engaged by the Contractor

No	Title/Designation	Duties/Roles
1	EHS Officer	• Assist the Contractor to Develop CESMPs • Supervision of Health and safety and implementation of Tool Box Talks • Implement Environmental Safeguards in the project to protect people and the environment • Prepare Sub-Project ESHIA Reports for various approvals and Permits • Coordinate environmental compliance in the project • Oversight waste management • Ensure environmental information reaches team leaders • Prepare environmental safeguards reports • Carry out surveillance on safety issues and safety training • Preparation of Environmental, Health and Safety Reports
3	Grievance Officer (Sociologist)	• Interface between the Contractor and the workers and Community • Support the Contractor on social safeguards and helps mobilize and organize Community and other stakeholder meetings. • Record incidences taking place during construction work and liaises with the Project Supervisor to address the emerging issues. • Record Grievances
3	Client Liaison Officer (CLO)	• Assist the Grievance and EHS Officers with communicating safeguards issues to the community • Attend Grievance Redress Committee (GRC) Meetings

8.4.2 Training, Education and Competency

Site Supervisor shall ensure that every employee/worker (direct or contractual) is aware of the EHS risks associated with the work being carried out at the site and is trained and competent in the relevant work practices and maintenance procedures. Training needs shall be identified and executed to ensure all staff are provided with adequate safety training for all levels of employees. The safety training should provide staff with the knowledge and skills necessary for organizing and managing occupational safety and health programmes. The team leaders with leadership skills and knowledge to lead should be supported to implement and apply occupational safety and health activities. Workers with the knowledge, skills and right attitudes should be encouraged/supported to enable them to work safely.

Areas that could be considered for training of various cadres of workers are:

- (HSE Policy and how it applies to the workplace;
- Hazards/Risks and Emergency Response Procedures);
- Importance of Safety Induction and Toolbox Talks;
- Appropriate use of Personal Protective Equipment (PPE).

The above inductions and trainings will improve on competency of the workers and lower incidence of injury and improvement on working safely.

8.4.3 Assessment and Improvement

It is noted that often projects collect data on environment, safety and social aspects of the project however this data is never evaluated for improvement on the implementation of the ESMP.

Data on injury incidences should periodically analysed considering source of injury, frequency of occurrence and whether any safety measures were overlooked so that improvements can be made on lessons learnt.

8.4.4 Incident Management

All incidences occurring within the project shall be managed through the incident management procedure that has been put in place and conforms with DOSHS. Every team that is carrying out a task must have a person appointed to be in charge. The officer in charge shall be familiar with all incident management protocols All the procedures for different occurrences shall be documented using appropriate forms as guided by DOSHS. Team leaders shall be sensitized on the use of the forms and the required protocols of reporting incidences and timeframe in which all incidences must be reported. The incident reporting forms must always be within reach of the team leader or EHS Officer.

8.4.5 Reporting

It should be ensured that provisions for reporting incidents, accidents and dangerous occurrences during construction are promptly done using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO). The team leader or Officer in charge of a Task Team shall be inducted on the reporting protocols and requirements. The training or induction shall include:

- Procedure of making a report on incidences;
- The protocol to be followed and reporting hierarchy;
- How the forms should be filled (without errors or omissions);
- Reporting timeframe.

8.4.6 Management Review

The project Environmental and social Management and Incident reports shall be prepared and submitted on a monthly basis. Review by management shall be done on a quarterly basis and feedback given to the safeguard's teams.

8.4.7 Liaison and Communication to Stakeholders

A stakeholder engagement plan shall be prepared to guide the process of engaging with stakeholders. The Stakeholder Engagement Plan is a crucial component of the Social Management Plans that will be implemented. Regular transparent communication between the project and the community and other stakeholders and vice versa is critical in building a good understanding between the parties involved. This good understanding shall be very important in managing unexpected situations that might arise during project implementation. The Stakeholder Engagement plan shall include some community Liaison measures for the operation phase as well. Communication to stakeholders has been carried out using different strategies as elaborated in **Table 81**.

Table 81: Liaison and Communication to Stakeholders

No	Stakeholder	Mode of Communication with Stakeholder	Activity
1	Key Stakeholders	Visit to their individual offices	• Key informant Interview regarding project • Filled in ESHIA Questionnaire
2	• Local Community • Key Stakeholders • Other Members	• Local Administration – PCM Posters • Radio Advert	Convened Public Consultation Meeting (PCM) to provide project information and potential impacts
3	Local Community	Local Administration	Administration of Socioeconomic Questionnaire
4	• Local Community • Key Stakeholders • Other Member of the public	• Local Administration – PCM Posters • Radio Advert	ESHIA Study to disclose Findings of the ESHIA Study – TBD

8.5 Environmental and Social Management Plan during Construction Phase

The impacts, mitigation measures, responsible party, monitoring indicator and allocation of costs pertaining to prevention, reduction and monitoring of significant negative impacts and maximization of positive impacts associated with the construction, operation and decommissioning phases of the proposed project are outlined in **Table 82.**

Table 82: Environmental and Social Management Plan

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
Construction Phase					
1	Hazardous waste on site	• Carry out a risk assessment of the waste • Develop a Hazardous Waste Management Plan • Remove hazardous waste from site by a NEMA Registered Firm for Hazardous Waste Disposal	• EHS Officer • Contractor	• Availability of detailed Waste Management Plan • Schedule for Site Clean-up • Clean-up Report	3,000,000/=
2	Change in Land Use	• Construction activities should be restricted to the project footprint • Restoration of the land to original stage after project life cycle	• EHS Officer • Contractor	• Final Design showing project footprint	Contractors BOQ
3	Loss of trees and vegetation	• Tree Planting activities should be enhanced in affected areas without interfering with the Solar Plant • Only cut down tree that must be cut	• EHS Officer • Contractor	• Report of Tree Planting Exercise	300,000/= pa
4	Solid Waste Generation	• Identify and pave waste collection points • Engage a NEMA approved was disposal firm for waste management • Contractor to prepare a detailed waste management plant for the management of solid waste at the site • Provision of waste bins on site	• EHS Officer • Contractor	• Availability of Solid Waste Management Plan • Contract of NEMA Registered Solid Waste Management Firm	200,000/= pa
5	Soil Erosion and Storm Water Run-off	• Provide adequate drainage facilities to allow water to flow from one side to the other • Do not heap excavated soil for long periods	• EHS Officer • Contractor	• Design Report on drainages provided • Regular report on status	Contractors BOQ
6	Labour influx into the project area	• The contractor to develop & implement a Labour Influx Management Plan and Workers' Camp & Accommodation Management Plans as part of C-ESMP and • Monitor all mitigation measures, including codes of conduct signed by all with physical presence on site, prioritization of local recruitment, induction of workers on GBV- SEA/SH, GRM for staff., avoid child and forced labour and enforce sub-contractor compliance of the same.	• EHS Officer • Contractor • Site Supervisor • Grievance Officer	• Labour Influx Management Plan • Monitoring reports	300,000/= pa

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
7	Occupational Health and Safety	• Provide condoms • Contractor to prepare a detailed Occupational Safety and Health Management Plan (OSHMP) that will provide all the required health and safety measures needed for the project activities • Workers to be provided with appropriate PPE • All workers to undergo health and safety induction before embarking on any work • Contractor to provide for regular toolbox talks on environmental protection and safety • Provide adequate and appropriately stocked First Aid Kits for site workers	• EHS Officer • Contractor • Site Supervisor	• Availability of detailed Occupational Safety Management Plan • Programme and records of Safety induction and Toolbox Talk	400,000/= pa
8	Community Health and Safety	• Make protective measures like condoms available • Contractor to prepare a detailed Community Safety and Health Management Plan (OSHMP) that will provide all the required health and safety measures needed for the project activities • Community to be sensitized on safety issues induction before embarking on any work •	• EHS Officer • Contractor • Site Supervisor • Grievance Officer	• Availability of detailed Community Safety Management Plan • Programme and records of Safety induction and Toolbox Talk	150,000/= pa
9	Impacts on soil	• Store hazardous chemicals on paved surfaces with containment • Use well maintained vehicles and machinery that do not leak oils or hydraulic fluids • Carry out soil analysis to establish status	• EHS Officer • Contractor	• Provision of Hazardous Waste Chain of Custody Forms • Soil Monitoring Report where impacts are recorded	200/000/= pa
10	Impacts on surface water	• Design and construct drainage systems within the facility so that storm water generated during construction does not end up on channels leading to streams or rivers within the project area • Monitor the quality of water at the nearest borehole/stream during the construction phase and record any changes in water quality	• EHS Officer • Contractor	• Design showing drainage • Water Quality monitoring report	100,000/= pa

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
		• Carry out water analysis to establish status.			
11	Fugitive Dust from Construction Activities	• Dust suppression by use of water • Instructing excavator machine operators to maintain low speeds • Monitor Air Quality on a regular basis • Provide workers with dust masks	• EHS Officer • Contractor	• Air Quality Monitoring Report • Reports on induction of drivers on site operation requirements	300,000/= pa
12	Fugitive Dust Generated by Vehicles driving in the project area	• Dust suppression by use of water • Instruct drivers to maintain low speeds • Monitor Air Quality on a regular basis • Provide workers with dust masks	• EHS Officer • Contractor	• Air Quality Monitoring Reports • Reports on induction of drivers on speed limits	200/000/= pa
13	Excess Noise from Vehicles and Machinery	• Instruct drivers to reduce speed of vehicles and minimize raving of engines • Drivers to minimise unnecessary hooting • Provide workers with ear muffs • Service vehicles and machinery regularly • Effect regular noise level monitoring	• EHS Officer • Contractor	• Noise Monitoring Reports • Reports on induction of drivers on speed limits	300,000/= pa
14	Exhaust Emissions	• Service vehicle and Machinery regularly • Provide workers with nose masks to guard against inhalation of exhaust gases • Carry out regular maintenance of vehicles and machinery • Carry out Air Quality Monitoring	• EHS Officer • Contractor	• Air Quality Monitoring Reports • Rerecords of Service of Vehicles and Machinery	300,000/= pa
15	Hazardous Material Spillage (Hydraulic fluids, engine oils and ither chemicals)	• Store hazardous materials in a secured area for proper management • Provide the storage area with a paved surface with containment • Maintain a chain of custody form for each hazardous material for accountability	• EHS Officer • Contractor	• Report on contained storage of hazardous materials • Completed Chain of custody forms	400,000/= pa
16	Social Vices GBV, VAC and SEA	• Contractor to develop and implement a GBV- SEA (Sexual Exploitation and Abuse and workplace Sexual Harassment	• EHS Officer • Grievance Officer • Contractor	• Reports on sensitisation initiatives conducted • GRM Records	200,000/= pa

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
		(SH) Management Plan, (including plans for prevention, response and GRM) • Contractor to ensure that a code of conduct is developed and signed by all with physical presence on site • Contractor to train and create awareness to local communities and workers on GBV Contractor to ensure that the project GRM provides confidential reporting, safe and ethical documenting of GBV cases. Contractor to ensure that the project does not trigger or exacerbate other forms of GBV at the community level by reviewing specific project components that are known to • heighten the GBV risk, and ensure effective and on-going community engagement and consultation, particularly with women and girls, among others. • Contractor can refer to the World Bank's Good Practice Note for Addressing Gender-based Violence in Investment Project Financing involving Major Civil Works (Sept 2018) for further guidance. • Establish sensitization initiatives /programs targeting locals e.g., on HIV/AIDS prevention • Establish a grievance redress mechanism (GRM) for the project and to ensure effective management of emerging issues. • Mainstream issues of gender, persons with disability into the overall project framework. • Prioritise employment of local labour where possible		• Employment records showing employment and disabled persons	
17	Potential Traffic Accident Risk (Site borders a major road)	• All drivers to be thoroughly inducted on driving safely when entering and exiting the site • Contractor to provide traffic marshals at the entrance to the site	• EHS Officer • Contractor	• Records of induction of Drivers on safe driving skills • Presence of traffic Marshals at the entrance to the site	500,000/= pa

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
18	Impacts on Ecology	• Prepare a Biodiversity Management Plan • Use existing roads for transportation of materials and constriction activities • Plant nurseries of the key species should be established for restoration in other areas to avoid complete loss of rare species • Control of invasive species should be done promptly to avoid their population explosions which in turn destabilize the growth of indigenous species • Vehicles and machinery entering the project site should be subjected to one off cleaning upon arrival to avoid introducing invasive species from other regions. Upon completion of work they should also be cleaned again so that they don't spread such species elsewhere • Unnecessary soil and vegetation disturbance should be avoided • An invasive species management programme should be developed by Bamburi's Lafarge Ecosystems experts for monitoring and control of the species • Waste disposal bins with secure lids should be provided at the site • Construction waste should be sorted and properly stored before proper disposal • Restore other areas in Bamburi where mining of cement construction materials has been decommissioned to help compensate for lost habitat to mammals • Clear vegetation from north to south sequentially in order to allow rodents etc to gradually migrate towards the nearby existing areas that are not active • Mount solar panels on raised pile, allowing room for vegetation growth below the panels	• EHS Officer • Contractor • Site Supervisor	• Biodiversity Management Plan • Reports on programme to implement recommendations	400,000/= pa

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
		• Where overhead transmission lines are used, attach bird flight diverters (typically flappers, balls or spirals) to transmission grounding wires to increase their visibility • Reptiles and amphibians are expected to move between habitats. The fence type should include under-passes that allow movement of crawling animals • Design for the project to consider including buffer zones between solar panel arrays • Mount solar above ground on post support spikes, rather than heavy foundations, maintaining habitats for both below and above-ground invertebrates • Use of white boarder or grids to break the polarized solar panel surfaces in order to reduce water invertebrate egg laying behaviours • Use of anti-reflective coatings (ARCs) to reduce the amount of polarized light pollution that they reflect, and hence their attractiveness to insects • Ensuring there is a good drainage system to avoid collection of water that may cause invertebrate assemblages			
19	Covid 19	• Provide facemasks to workers and a bin for temporary facemasks disposal on site • The bin should be emptied and disposed as infectious hazardous waste according to NEMA guidelines on Covid-19 waste disposal. • Hand wash facility with clean water should be provided. • Ensure all workers undergo mandatory temperature test every morning. • Ensure that conveniently accessible, clean, orderly, adequate and suitable sanitary facilities are provided and maintained within the site • Ensure employees keep distance when working	• EHS Officer • Grievance Officer • Contractor	• Availability of Covid 19 Sanitation equipment (digital thermometer • Presence of trained Officer at entrance to monitor temperatures and sanitize those entering premises	400,000/= pa

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
		• Anybody with flu like symptoms should be taken for further management at the clinic or dispensary • There should be strict observance of social distancing during transportation to work site			
20	Grievances Redress Mechanism	• Contractor to develop an effective project GRM to ensure every grievance is registered, documented, fully addressed and closed out. GRM to ascertain anonymity and confidentiality ascertain anonymity and confidentiality	• Grievance Officer • Contractor	• Availability of an effective Grievance Redress Mechanism • Set up a Grievance Redress Committee	200,000/= pa
21	Spread of communicable diseases, HIV/ AIDs and other sexually transmitted diseases	• Contractor to develop and implement a STD/HIV/AIDS awareness plan on prevention and mitigation • Sensitise workers and community on communicable diseases	• EHS Officer • Grievance Officer • Contractor	• STD/HIV/AIDS awareness plan	200,000/=
Operation Phase					
1	Solid Waste	• Ensuring efficient solid waste management • Provision of waste bins with secure lids	• Momnai Energy • Site Manager	• Solid Waste Management Plan • Availability of Waste Bins	50,000/= pa
2	Storm Drainage Water at the site	• The proponent to ensure there is adequate means for handling storm water to be collected from the solar arrays. • A well-planned drainage system that will allow growth of for diverting storm water runoff	• Momnai Energy • Site Manager	• Drainage Infrastructure Reports	100/000/= pa
3	Occupational Health and Safety of Workers	Workers to be provided with appropriate PPE including: • Anti-glare glasses and • Harnesses for working at heights	• Momnai Energy • Site Manager	Availability of PPE	200,000/= pa

No	Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Cost (KShs)
Decommissioning Phase					
1	Solid Waste Management	• Provision of waste handling bins • Appropriate Segregation of waste for proper disposal and reuse of other materials • Involvement of a NEMA Registered Firm for Hazardous materials	• Momnai Energy • Site Manager • Decommissioning Contractor	• Approved Decommissioning Plan	200,000/=
2	Fugitive Dust Management	• Dust suppression by use of water • Instructing excavator machine operators to maintain low speeds • Monitor Air Quality on a regular basis • Provide workers with dust masks	• Momnai Energy • Site Manager • Decommissioning Contractor	• Air Quality Monitoring Reports during decommissioning	• 100,000/=
3	Exhaust Emissions	• Service vehicle and Machinery regularly • Provide workers with nose masks to guard against inhalation of exhaust gases • Carry out regular maintenance of vehicles and machinery	• Momnai Energy • Site Manager • Decommissioning Contractor	• Air Quality Monitoring Reports during decommissioning	• 100,000/=
4	Excess Noise from Vehicles and Machinery	• Instruct drivers to reduce speed of vehicles and minimize raving of engines • Minimise hooting unnecessarily • Provide workers with ear muffs • Service vehicles and machinery regularly	• Momnai Energy • Site Manager • Decommissioning Contractor	• Noise Monitoring Reports during decommissioning	• 100,000/=
5	Restoration of site	• Site revegetation through planting of indigenous trees	• Momnai Energy • Site Manager • Decommissioning Contractor	• Restoration Plan	5000,000/=

8.5.1 Biodiversity Management Plan

The biodiversity management plan (ESHMP subset) for flora and fauna in Athi River site is presented in **Table 83** below. This matrix provides recommended management and monitoring activities based on the mitigation measure proposed above counteract the probable impacts. It provides management actions, monitoring indicators and identifies the responsible persons/organization for the implementation.

Table 83: Ecological (Biodiversity) Management and Monitoring Plan

Biodiversity component	Aspect/Indicator	Goal	Action	Monitoring frequency	Responsible	Cost (KShs)/ Year
Flora	Plant species and vegetation around the project area	To safeguard loss of important species from the site such as big trees growing at the project periphery and protected species	i) Retain mature trees such as *Acacias* and *Shinus molle* ii) Relocate individuals of the CITES listed *Aloe secundiflora* to areas that are not likely to be disturbed iii) Plant indigenous species on empty spaces where possible	Quarterly	Momnai Energy	200,000
Flora	Proliferation of Invasive species	To control influx of invasive species within Athi River Solar plant and the AOI	i) Monitor and physically remove invasive species as they appear ii) Vehicles and machinery entering the project site should be subjected to one off cleaning upon arrival to avoid introducing invasive species from other regions. Upon completion of work they should also be cleaned again so that they don't spread such species elsewhere	Quarterly	Momnai Energy	200,000
Flora	Waste discharge	To monitor and avoid possible negative impacts of solid or liquid waste on species	i) Conduct staff induction on best waste management practices ii) Garbage bin should be provided at convenient points within the project area iii) Garbage bins should be regularly emptied and lids properly secured to avoid waste spillage by animals	Monthly	Momnai Energy	1.5M
Fauna - Birds,	Safeguarding survival of	To monitor and rescue fauna	ii) Vegetation clearing should be	Daily	Momnai Energy	150,000

Biodiversity component	Aspect/Indicator	Goal	Action	Monitoring frequency	Responsible	Cost (KShs)/ Year
mammals, reptiles, amphibians, and invertebrates	the fauna whose habitat is lost due to vegetation clearing	that may appear stranded after the habitat loss	done in a way that drives animals towards safe natural habitats e.g. towards Nairobi National Park, ii) Capture and relocate any slow moving animals e.g. snakes found on the project area during clearing or at any other time to secure natural habitats e.g. NNP			
Fauna - Birds, mammals, reptiles, amphibians, and invertebrates	Changes (decline or influx) of species within and around the project area	To understand the general trends of various flora and fauna species during the project tenure	Design and implement taxa specific monitoring protocols and maintain databases	Quarterly	Momnai Energy	2M
Fauna - Birds, Bats, Invertebrates	Light pollution	To understand the impact of lighting at the project site on nocturnal fauna	Document and monitor cases of birds and bats disorientation and risks due to effects of light	Daily	Momnai Energy	1M
Fauna - Birds, mammals, reptiles, amphibians, and invertebrates	Dust pollution	To understand the impact of fugitive dust during construction phase on flora and fauna	Assess layer of dust accumulated on plant leaves in project surrounding area	Monthly	Momnai Energy	150,000
Fauna – Birds, mammals, reptiles, amphibians, and invertebrates	Solid and liquid waste discharge	To assess and monitor negative impacts of waste discharge on fauna	i) Document incidents of species poisoning or die offs ii) Document the formation of new microhabitats iii) Document species trends in terms of abundance and diversity	Weekly	Momnai Energy	300,000
Fuana – Birds,	Species displacement	To monitor incidences of birds	Document cases of birds and	Daily	Momnai Energy	250,000

Biodiversity component	Aspect/Indicator	Goal	Action	Monitoring frequency	Responsible	Cost (KShs)/ Year
Invertebrates	due to attraction to reflective surfaces of solar panels - "Lake effect"	and invertebrate displacement to solar panel surfaces	invertebrates' interactions with the solar panels			
Birds and Bats	Collisions with solar panels	To monitor incidences of bird and bat collisions with solar panels	Document number of collision cases and frequency by species	Daily	Momnai Energy	250,000
Herpetofauna	Loss/modification of critical microhabitats	To monitor reptile and amphibian activity patterns and spatial occurrence	Document amphibian and reptile breeding or feeding sites and hatchlings	Monthly	Momnai Energy Consultant Expert	150,000
Herpetofauna	Species influx to modified habitats	To monitor herpetofauna colonization of spaces under the solar panels	Document amphibian and reptile abundance and diversity within the PV grid matrix	monthly	Momnai Energy	150,000
Herpetofauna, small mammals, invertebrates	Loss of dispersal corridors	Monitor species movements and habitat utilization within the solar panel grid and surrounding areas	Report on reptile, amphibian, mammal and invertebrate occurrence records within the project area	Monthly	Momnai Energy	400,000

8.6 Environmental and Social Monitoring Plan

8.6.1 Monitoring Framework

Environmental and Social monitoring is envisioned as an important process in project management. The monitoring programme will reveal changes and trends brought about by the presence and operations of the project. Such information will be useful in the formulation of sustainable project management and operation strategies. The basic activities for a sound-monitoring programme for the Solar Plant should at least include the following parameters:

- Collection and analysis of relevant environmental and social data of the site including:
  - ✓ Evaluation of the site vegetation cover that is to be cleared before construction
  - ✓ Evaluation of the type and quantity of solid waste generated at the construction site
  - ✓ Inspection of the materials being used;
  - ✓ Evaluation of the construction practices;
  - ✓ Monitoring of noise generation during construction and comparison with baseline measurements
  - ✓ Monitoring of dust generation during construction and comparison with baseline measurements
  - ✓ Monitoring to ensure to prevent invasion by exotic species;
  - ✓ Monitoring of health and safety issues (accidents and injuries and causes) and carrying out analysis to see trends and use them corrective action
  - ✓ Evaluation of noise generation and duration during construction activities and comparison with baseline measurements;
  - ✓ The amount of water consumed during the construction and operation phases;
  - ✓ Monitoring of diseases within the workforce;
- Identification of unexpected environmental and social impacts;
- Formulation of counter-measures to mitigate unexpected negative impacts and comparing them with actual impacts as identified during the assessment.

Internal Monitoring of the project activities will be carried out as follows:

Safeguards officers (EHS and Grievance Officerare to carry out daily monitoring of safeguards compliance by Contractor. They are to convene regular safeguards meetings (weekly) to discuss environmental, social and OHS issues and performance . They are to ensure Contractor organises brief daily toolbox talks on Health and Safety.

- Incident/accident notification and reports are to be prepared and submitted within 24 hours
- Safegurds Reports (Environmental, Social and OHS) to be submitted on a monthly basis
- Monitoring of environmentalparameters are to be carried out as stipulated in the monitoring pan and reports prepared and submitted to the Site Supervisor for onward transmission to the Project Management Team

Table 84 provides safeguards monitoring activities to be carried by different project implementation offices.

Table 84: Internal Environmental and Social Monitoring of Project Activities

Officers	Activity	Aspects/Parameters	Output
EHS Officer	Carry out environmental safeguards inspection of construction	• Carry out daily supervision and monitoring of the ESMP Compliance by Contractor • Carry out daily supervision and monitoring Monitoring of OHS compliance by Contractor	• Daily records of inspection findings • Preparation of environmental

Officers	Activity	Aspects/Parameters	Output
	activities on a daily basis	• eview of includig CESMPs, permits, safety induction, meetings and tool box talks • Inspection of waste management at the camp and construction sites • Inspection of Environmental protection (Garage, Workshop, field etc) • Inspection of traffic management and signages • Inspect[on of PPE use by workers • Facilitation of monitoring of environmental aspects (air, noise, water) • preparation of incident records and reports	safeguards monthly reports
Grievance Officer (Sociologist)	Carry out social safeguards inspection of the construction activities	• Review social safeguards documents • Facilitation of GRM performance • Facilitation of Stakeholder/ Community Engagement/Meetings • Facilitation of involvment of VMGs in project activities • Review labour influx and its impact on VMGs • Review of GBV and Violence Against Children (VAC) • Facilitation of monitoring of social aspects • Providision of guiidance on non-compliance to Contractor	Preparation of social safeguards monthly reports

The ESHIA study has revealed that the proposed project will generate some impacts that require mitigation measures during construction period. These potential impacts will also require close monitoring during construction and post construction period.

Monitoring will involve measurements, observations, evaluations, assessment and reporting on various variables during construction and operation.

8.6.2 Monitoring Plan

Arising from the study, the aspects to be monitored are given in **Table 85.**

Table 85: Environmental and Social Monitoring Plan (Monitoring Plan)

Location	Environmental/ Social Component	Monitoring Requirements	Performance Indicators	Frequency of monitoring/ Duration	Responsibility
1. Construction					
Contractor's Camp	Public health and safety	• Reports from Community • Physical inspection • EHS records • Incident logs maintained by Contractor	• Provision of condoms, contraceptives and mosquito nets. • No of campaign meetings on transmission of diseases like HIV/AIDS and other STDs. • Availability of adequate solid waste bins and waste disposal procedures • Availability of first aid facilities. • Outpatient attendance registers. • Prevalence rates of common diseases. • Compliance with the Occupational Safety and Health • Compliance with Public Health Act.	Monthly	• EHS Officer • Grievance Officer • Contractor
	Solid and liquid wastes from Offices and Residential areas	• Physical inspection of Camp • Physical inspection of sewage system • Number of complaints	• Presence of scattered litter. • Confirm records of waste disposal • Signs of obstruction of water courses. • Evidence of engaging a NEMA registered waste disposal firm	Monthly	• EHS Officer • Contractor
	Hazardous/Chemical waste (Used Oil, Oil filters, hydraulic fluids and Lubricants)	• Physical inspection of Garage and workshops • Records of hazardous waste handling and disposal	• Presence of oil spillage • Chain of custody forms for handling, storage and transportation for disposal by NEMA registered firm • Contract of NEMA Registered Firm	Weekly	• EHS Officer • Grievance Officer • Contractor
	HIV&AIDS	• Inspection of HIV/AIDS prevention services in the project • Number of condoms, ARVs provided.	• Number campaign meetings on transmission of diseases like HIV/AIDS and other STDs. • Number of condom dispensers within the site. • Number of ARVs provided to vulnerable persons	Quarterly	• EHS Officer • Grievance Officer • Contractor

Location	Environmental/ Social Component	Monitoring Requirements	Performance Indicators	Frequency of monitoring/ Duration	Responsibility
Material Sites (Quarry, Borrow Pits)	Solid and liquid wastes	• Physical inspection • Number of complaints	• Scattered litter • Signs of obstruction of water ways. • Flow of wastewater on the ground surface. • Provision of sanitary facilities to the construction crews.	Monthly	• EHS Officer • Contractor
	Noise	• Documentation on complaints about noise • Carry out noise daily measurements • Zone out elevated noise areas for mandatory use of PPE (ear muffs)	• Level of noise generated.at site during construction, quarry/borrow pit • Provision of PPE. • Compliance with existing noise standard issued by NEMA. a) **Health, Educational facility** *109 dB(C) Max* b) **Residential, Commercial Facilities** *114dB(C)*	• Use of portable equipment to monitor noise levels on regular and adhoc basis • Monitor daily during active operation	• EHS Officer • Contractor
	Air Pollution • Exhaust emissions • Fugitive dust	• Physical inspection • Interview residents including workers • Liaise with other stakeholders • Carry out daily air quality measurements (SO_x, NO_x, PM_{10} and HC)	• Level of dust generated. • Provision of PPE. • Compliance with existing air quality standards issued by NEMA - Sulphur Oxides (SO_x) - 60µg/m^3 - Oxides of Nitrogen (NO_x) - 60µg/m^3 - Respirable Particulate Matter (RPM) -50µg/m^3 - Total Volatile Organic Compound (VOC) - 600µg/m^3	• Use of portable equipment to monitor air pollution on regular and adhoc basis • Monitor daily on active operation	• EHS • Contractor
	Rock Blasting causing damage to structures	• Physical inspection • Field determination of area of influence	• Area of influence of the rock blasting • Baseline status of nearby structures	After every blast	• EHS • Grievance Officer • Contractor
Site Construction Activities	Vibration causing damage to neighboring structures	• Physical Inspection • Field measurement of vibration level and distance of influence.	• Establish baseline of existing structures neighboring the road • Compliance with existing noise standard issued by NEMA.	Monthly	• EHS • Contractor

Location	Environmental/ Social Component	Monitoring Requirements	Performance Indicators	Frequency of monitoring/ Duration	Responsibility
	Air Pollution • Exhaust emissions • Fugitive dust	• Physical inspection • Interview residents including workers • Liaise with other stakeholders • Carry daily out air quality measurements (SO_x, NO_x, PM_{10} and HC)	• Level of dust generated. • Compliance with existing air quality standards issued by NEMA - Sulphur Oxides (SO_x) - 60µg/m^3 - Oxides of Nitrogen (NO_x) - 60µg/m^3 - Respirable Particulate Matter (RPM) -50µg/m^3 - Total Volatile Organic Compound (VOC) - 600µg/m^3	• Use of portable equipment to monitor air pollution on regular and adhoc basis. • Monitor 3 times a week near settlement centres and institutions like mosques, hospitals and schools	• EHS • Contractor
	Traffic Management during the day	• Physical inspection of the road under construction to ensure flagmen are active and road signs are in place • Maintaining low speeds	• Incident records • Accidents • Compliance with approved traffic management plan	Daily	• EHS • Contractor
	Traffic Management at night	• Installation of retro-reflective road signs near site turning • Physical Inspection of signs	• Incident records • Accidents	Daily	• EHS • Contractor
	Drainage Discharge causing damage	• Physical inspection of water drainage discharge routes • Reports from Community • Damage caused	• Registered complaints of damages • Records of damage caused	Weekly during the rainy season when drainages contain water	• EHS • Contractor
	Noise	• Documentation on complaints about noise • Carry out daily • noise measurements • Zone out elevated noise areas for mandatory use of PPE (ear muffs)	• Level of noise generated. • Provision of PPE. • Compliance with existing noise standard issued by NEMA. a) **Residential Outdoor** *Day - 50 dB(A), Night – 35 dB(A)* b) **Place of Worship** *Day – 40dB(A), Night - 35dB(A)*	• Use of portable equipment to monitor noise levels on regular and adhoc basis • Monitor daily during active operation	• EHS • Grievance Officer •

Location	Environmental/ Social Component	Monitoring Requirements	Performance Indicators	Frequency of monitoring/ Duration	Responsibility
	Flora and Fauna	• Records of uprooted trees • Physical observation	• Amount of vegetation removed • Change in animal behavioral pattern	Quarterly	• Environmental Supervisor
	Gender Empowerment	• Review of company staff records. • Physical Inspection	• Number of female employees • Number of male and female toilets	Quarterly	• Grievance Officer
	Crime Management and security	• Review of records • Interviews with staff and local community	• Number of reported crimes • Number of complaints	Monthly	• EHS • Grievance Officer
	Impacts on Children	• Review of records • Interviews with staff and local community	• Record of employees including IDs	Monthly	• Grievance Officer
	GBV, Sexual Exploitation and Abuse	• Review of grievance redress forms. • Interviews with local community	• Number of complaints	Monthly	• Grievance Officer
	Loss of Life, Injury and Damage to Private property	• Interviews with staff and local community. • Review of records	• Record of accidents and damages done	Monthly	• EHS Officer • Contractor • Grievance Officer
	Labour Influx	• Interviews with local administration on influx and conflicts • Complaints log • Interviews with grievance committee members	• Number of grievances • Incidences of conflicts	Monthly	• Grievance Officer

Location	Environmental/ Social Component	Monitoring Requirements	Performance Indicators	Frequency of monitoring/ Duration	Responsibility
	Increased Conflicts	• Police incidence reports • Information from Local Administration • Grievance/Complaints logs	• Records of conflicts with local administration • Number of grievances • Complaints logs	Monthly	• Grievance Officer
Operation					
Operational Solar Plant	Bird kills	• Inventory of birds killed by solar infrastructure	• No of birds • Species	Daily	Site Maintenance Officer
	Drainage damages	• Damaged areas	• Records of damages • Records of complains from Community	Rainy Season	Site Maintenance Officer
	Water use	• Frequency of panel cleaning	• Quantity of water used	Monthly	Site Maintenance Officer

Source: *ESHIA Study, 2021*

9 COMMUNITY DEVELOPMENT ACTION/FRAMEWORK

Corporate Social Responsibility (CSR) is a management concept whereby organizations integrate social and environmental concerns in their business operations and interactions with their stakeholders. CSR generally is the way through which a company achieves a balance of economic, environmental and social imperatives ("Triple-Bottom-Line- Approach"), while at the same time addressing the expectations of shareholders and stakeholders.

Promoting the uptake of CSR amongst a community requires approaches that fit the respective needs and capacities of these communities and do not adversely affect their economic, social and environmental viability. It is an attempt to align private enterprises to the goal of sustainable global development by providing them with a more comprehensive set of working objectives than just profit alone. The perspective taken is that for an organization to be sustainable, it must be financially secure, minimize (or ideally eliminate) its negative environmental impacts and act in conformity with societal expectations.

Key CSR issues: environmental management, eco-efficiency, responsible sourcing, stakeholder engagement, labour standards and working conditions, employee and community relations, social equity, gender balance, human rights, good governance, and anti-corruption measures.

9.1 Need for Community Action Plan and CSR

The Consultant engaged with the local community and from these consultations, certain socio-economic areas were found to be inadequate. The community suggested areas of interest to them.

9.1.1 Proposed Activities

The following activities were identified as inadequate in the area and the communit6y would appreciate if the proponent would assist in implementing all or some.

- Source of clean drinking water;
- Youth Employment;
- Upgrade of feeder roads;
- Street lighting;
- Bursaries for needy students.

9.1.2 Implementation Plan

The above requests from stakeholders and communities have been shared with the project proponent for follow-up and appropriate action.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Introduction

The conclusions and recommendations have been provided here to highlight the key findings and recommendations. Data related to the Study have been provided in the main report and Appendices of this report.

10.2 Conclusions

The environmental, social and Health Impact Assessment (ESHIA) of the proposed Solar Plant at Athi River Site has been conducted in accordance with national legislative requirement, the World Bank Policies, IFC's Performance Standards and World Bank's Environmental Health and Safety (EHS) Guidelines, EIB Environmental and Social Standard and International Labour Organization (ILO) Convention. The ESHIA study has been carried out based on the site visit, baseline environmental and social condition survey including Specialized Ecological Study on biodiversity, stakeholder consultation, analysis of the possible project intervention. The experts identified and evaluated potential environmental impacts associated with all aspects of the proposed project.

The proposed project is going to be developed on a parcel of land located within am area that is occupied by large industries. The land was previously excavated to provide raw materials for Nairobi Grinding Plant and was yet to be rehabilitated. Since the land in not fenced, members of the public have been dumping hazardous waste in the middle section of the land. The land is privately owned by Bamburi Cement.

The key potential environmental impacts due to the project construction as established by the ESHIA study are change on land use, some loss of vegetation, drainage pattern change, moderate loss of habitat for small mammals, insects and amphibians, solid waste generation and disposal, increase in traffic and occupational health and safety. The economic opportunities in terms of local employment and provision of services during construction and operation phases are assessed as positive. During the operation of the proposed project, the key issues related to the environment has been identified from the ESHIA study are ecological, visual impact and occupational health and safety.

The Environmental and Social Management Plan (ESMP) has described mitigation measures for impacts specific to the project activities and also discuss implementation mechanism for recommended mitigation measures along with a monitoring plan. Implementation of the ESMP will help the developer to comply with the national regulatory framework as well as to meet IFC Performance Standard requirements.

10.3 Recommendations

The Solar PV Power Plant can be implemented at the proposed site. All the mitigation measures provided in the ESMP and the Monitoring Plan need to be implemented as indicated to safeguard the biodiversity and physical environment of the project area. Health and Safety of the workers and community members have also been identified as key areas that require dedicated observance. Environmental, Social and Health issues of the project need to monitored and data analysed and used to improve the safeguards performance of the project.

BIBLIOGRAPHY

Abbasi SA, Abbasi N. 2000. The likely adverse environmental impacts of renewable energy sources. Applied Energy 65: 121–144.

Adams, A.M., Mcguire, L.P., Hooton, L.A., Fenton, M.B. 2015. How high is high? using percentile thresholds to identify peak bat activity. Canadian Journal of Zoology. 93:307-313.

Agnew, D.Q., Agnew, S. 1994. Upland Kenya Wild Flowers.

Agnew A.D.Q. (3rd Ed.) 2013. Upland Kenya Wild Flowers and Ferns: A flora of the Flowers, Ferns, Grasses and Sedges of Highland Kenya. Nature Kenya – The East African Natural History Society, Nairobi.

Algers, B. and Hennichs K. (1983) Biological effects of electromagnetic fields on vertebrates. A Review. Veterinary Research Communications 6:265-279.

Barros, M.A.S., Pessoa, D.M.A., & Rui, A.M. (2014). Habitat use and seasonal activity of insectivorous bats (Mammalia: Chiroptera) in the grasslands of southern Brazil. Zoologia, 31: 153-161.

Beentje H.J., 1994. Kenya, Trees, Shrubs and Lianas. National Museums of Kenya, Nairobi.

Bennun, L. A. and Njoroge, P. (1999). Important Bird Areas of Kenya. East Africa Natural History Society. Bennun & Howell, 2000 and Sutherland, 1996

Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N., Carbone, G. (2021). Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers. Gland, Switzerland: IUCN and Cambridge, UK: The Biodiversity Consultancy.

Bernard RTF, Happold M. 2013c. Nycteris thebaica Egyptian Slit-Faced Bat. In: Happold M, Happold D. Mammals of Africa, Volume IV: Hedgehogs, Shrews and Bats. London: Bloomsbury Publishing, 457–460.

Bibby, C. J., N. D. Burgess, D. A. Hill, and S. H. Mustoe. 2000. Bird census techniques. Academic Press, London, UK.

BioNET-EAFRINET, (2011). A Lucid key and fact sheets to 100 most important invasive alien plant species in the East African region. http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/index.htm . Accessed 08 December 2021

Carey, AB., Biswell, BL. and Witt, JW. 1991 Methods for measuring the abundance of arboreal rodents. USDA Forest Service, technical report, Oregon.

Channing, A. and Rödel, M.O., 2019. Field guide to the frogs & other amphibians of Africa. Penguin Random House South Africa.

CITES, 2015. A list of Fauna and Flora protected against International Trade. http://www.cites.org/sites/default/files/eng/app/2015/E-Appendices-2015-02-05.pdf

Collar, N. J. and Stuart, S. N. (1985). Threatened Birds of Africa and Related Islands: The ICPB/IUCN Red Data Book, ICPB/IUCN Cambridge

Cushman, S.A., 2006. Effects of habitat loss and fragmentation on amphibians: a review and prospectus. Biological conservation, 128(2), pp.231-240.

Daubenmire, R.F. 1959. A canopy -cover method of vegetational analysis. Northwest Science, 33:43 - 46.

Dieterlen F. 2013. Acomys kempi Kemp's Spiny Mouse. In: Happold DCD. Mammals of Africa, Volume III: Rodents, Hares and Rabbits. London: Bloomsbury Publishing, 225–226.

Drewitt AL, Langston RHW. 2006. Assessing the impacts of wind farms on birds. Ibis 148: 29–42.

Eric J. N., Julian C., Lin S., Designing solar farms for synergistic commercial and conservation outcomes, Solar Energy, Volume 228, 2021, Pages 586-593, ISSN 0038-092X, https://doi.org/10.1016/j.solener.2021.09.090.

Estrada, A., Jiménez, C., Rivera, A., & Fuentes, E. (2004). General bat activity measured with an ultrasound detector in a fragmented tropical landscape in Los Tuxtlas, Mexico. Animal Biodiversity and Conservation, 27(2):5-13.

Fenton, M.B. (1970). A technique for monitoring bat activity with results obtained from different environments in southern Ontario. Canadian Journal of Zoology, 48(4):847-851. https://doi.org/10.1139/z70-148

Field JP, Belnap J, Breshears DD, Neff JC, Okin GS, Whicker JJ, Painter TH, Ravi S, Reheis MC, Reynolds RL. 2010. The ecology of dust. Frontiers in Ecology and the Environment 8: 423–430.

Frick, W.F. (2013). Acoustic monitoring of bats, considerations of options for long-term monitoring. Therya, 4(1):69-78. ttps://doi.org/10.12933/therya-13-109 Gurnell J, Lurz PWW, Shirley MDF et al. (2004) Monitoring red squirrels Sciurus vulgaris and grey squirrels Sciurus carolinensis in Britain. Mamm Rev 34: 51–74.

Frost, Darrel R. 2021. Amphibian Species of the World: an Online Reference. Version 6.1 (Date of access). Electronic Database accessible at https://amphibiansoftheworld.amnh.org/index.php. American Museum of Natural History, New York, USA. doi.org/10.5531/db.vz.0001 . Accessed on 12th November, 2021.

Happold DCD. 2013a. Hystrix cristata Crested Porcupine. In: Happold DCD. Mammals of Africa, Volume III: Rodents, Hares and Rabbits. London: Bloomsbury Publishing, 678–679.

Happold M. 2013b. Epomophorus wahlbergi Wahlberg's Epauletted Fruit Bat. In: Happold M, Happold D. Mammals of Africa, Volume IV: Hedgehogs, Shrews and Bats. London: Bloomsbury Publishing, 249–251.

Happold DCD. 2013C. Gerbilliscus nigricaudus (Peters, 1878) Black-tailed Gerbil. In: Happold DCD. Mammals of Africa, Volume III: Rodents, Hares and Rabbits. London: Bloomsbury Publishing, 281–282.

Hernandez R. R., Easter S. B., Murphy-Mariscal M. L., Maestre F. T., Tavassoli

M., Allen E. B., Barrows C. W., Belnap J., Ochoa-Hueso R., Ravi S., Allen M. F., Environmental impacts of utility-scale solar energy, Renewable and Sustainable Energy Reviews, Volume 29, 2014, Pages 766-779, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2013.08.041.

Hernandez R. R., Hoffacker M. K., Murphy-Mariscal M. L., Wu G. C., Allen M. F. (2015) Solar energy development and land cover change Proceedings of the National Academy of Sciences Nov 2015, 112 (44) 13579-13584; DOI: 10.1073/pnas.1517656112.

Heyer, W.R., M.A. Donnelly, M.R.W. Diarmid, L.-A. C. Hayek, & M.S. Foster (eds.) (1994). Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press, Washington D.C.

Heyer, R., Donnelly, M.A., Foster, M. and Mcdiarmid, R. eds., 2014. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institution.

Happold M. 2013c. Cardioderma cor Heart-nosed Bat. In: Happold M, Happold D. Mammals of Africa, Volume IV: Hedgehogs, Shrews and Bats. London: Bloomsbury Publishing, 404–405.

Hoffmann M, Kingdon J. 2013a. Nesotragus moschatus Suni. In: Kingdon J, Hoffmann M. Mammals of Africa, Volume VI: Pigs, Hippopotamuses, Chevrotain, Giraffes, Deer and Bovids. London: Bloomsbury Publishing, 214–219.

Hölker, F., Wolter, C., Perkin, E.K., Tockner, K. 2010. Light pollution as a biodiversity threat. Trends in Ecology and Evolution 25, 681–682.

Horváth G., Blahó M., Egri A., Kriska G., Seres, I., and Robertson, B. (2010). Reducing the Maladaptive Attractiveness of Solar Panels to Polarotactic Insects. Conservation biology: the journal of the Society for Conservation Biology. 24. 1644-53. DOI: 10.1111/j.1523-1739.2010.01518.x

IFC, 2019. Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. Available from: www.ifc.org. www.ifc.org.

Isbell LA, Enstam-Jaffe KL. 2013. Chlorocebus pygerythrus Vervet Monkey. In: Butynski TM, Kingdon J, Kalina J. Mammals of Africa, Volume II: Primates. London: Bloomsbury Publishing, 277–283.

IUCN (2021) Mammals. IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org/initiatives/mammals [accessed 04th December 2021].

IUCN 2021. The IUCN Red List of Threatened Species. Version 2021-2. https://www.iucnredlist.org. Accessed on 7th December, 2021.

Jeal C., Perold V., Ralston-Paton S., Ryan P. G., 2019. Impacts of a concentrated solar power trough facility on birds and other wildlife in South Africa. Ostrich 90: 129–137. doi: 10.2989/00306525.2019.1581296.

Karns, D. R. (1986). Field Herpetology: Methods for the study of Amphibians and Reptiles in Minnesota. James Ford Bell Museum of Natural History, University of Minnesota, Occasional Paper: No. 18 September 1986.

Kingdon, J. 2015. Kingdon field guide to African mammals 2nd edition. Bloomsburg publishing. London-UK.

Kunz, T.H., C.R. Tidemann and G.C. Richards. 1996. Small volant mammals. In: (D.E. Wilson, F.R. Cole, J.D. Nichols, R. Rudran and M. S. Foster, eds) Measuring and Monitoring Biological Diversity: Standard Methods for Mammals. Smithsonian Institution Press, Washington, D.C. pp. 24-89.

Kunz, T.H. and A. Kurta. 1988. Capture methods and holding devices. In: (T.H. Kunz, S. Parsons, eds) Ecological and behavioral methods for the study of bats. The Johns Hopkins University Press, Baltimore. pp. 1-29.

Kunz TH, Arnett EB, Erickson WP, Hoar AR, Johnson GD, Larkin RP, Strickland MD, Thresher RW, Tuttle MD. 2007. Ecological impacts of wind energy development on bats: Questions, research needs, and hypotheses. Frontiers in Ecology and the Environment 5: 315–324.

Kuvlesky WP Jr, Brennan LA, Morrison ML, Boydston KK, Ballard BM, Bryant FC. 2007. Wind energy development and wildlife conservation: Challenges and opportunities. Journal Wildlife Management 71: 2487–2498.

Leirs H. 2013. Mastomys natalensis Natal Multimammate Mouse. In: Happold DCD. Mammals of Africa, Volume III: Rodents, Hares and Rabbits. London: Bloomsbury Publishing, 468–740.

Lovich JE and Ennen JR. 2011. Wildlife Conservation and Solar Energy Development in the Desert Southwest, United States. BioScience 61: 982–992. doi:10.1525/bio.2011.61.12.8

Marani, M. (1995). Spacial - temporal variations of hydrogen sulphide levels around the Olkaria geothermal power plant. M.Phil thesis, Moi University, 182 pp.

McDiarmid, R.W., Foster, M.S., Guyer, C., Chernoff, N. and Gibbons, J.W. eds., 2012. Reptile biodiversity: standard methods for inventory and monitoring. Univ of California Press.

Mburu J. 2005. Economic valuation and environmental assessment. Training Manual, Kakamega Kenya.

*Mganga KZ, Musimba NKR, Nyariki DM., Nyangito MM, Mwang'ombe AW. 2013. The choice of grass species to combat desertification in semi-arid Kenyan rangelands is greatly influenced by their forage value for livestock. Grass and Forage Science **70**: 161-167.*

Miller, B.W. (2001). A method for determining relative activity of free flying bats using a new activity index for acoustic monitoring. Acta chiropterologica, 3(1):93-105.

Monadjem, A., Mahlaba, T.A., Dlamini, N., Eiseb, S.J., Belmain, S.R., Mulungu, L.S., Masssawe, A.W., Makundi, R.H., Mohr, K. and Taylor, T. 2011. Impact of crop cycle on movement patterns of pest rodent species between fields and houses in Africa. Wildlife Research 38: 603-609 http://dx.doi.org/10.1071/WR10130.

Munson SM, Belnap J, Okin GS. 2011. Responses of wind erosion to climate-induced vegetation changes on the Colorado Plateau. Proceedings of the National Academy of Sciences 108: 3854–3859.

Mutangah, J.G, Musila, W.M., Mwangangi, O.M. and Muiruri V. (1997). The vegetation of Makongo remnant forest in Makueni district. Plant Conservation Programme, National Museums of Kenya.

Musila, S., Chen, ZZ., Li, Q., Yego, R., Zhang, B., Onditi, K., Muthoni, I., He, SW, Omondi, S., Mathenge, J., Kioko, EN, Jiang, XL. 2019. Diversity and distribution patterns of non-volant small mammals along different elevation gradients on Mt. Kenya, Kenya. Zool Res. 18(1): 53-60. doi: 10.24272/j.issn.2095-8137.2019.004.

Musila, Simon & Bogdanowicz, Wieslaw & Syingi, Robert & Zuhura, Aziza & Chylarecki, Przemysław & Rydell, Jens. 2019. No lunar phobia in insectivorous bats in Kenya. Mammalian Biology. 95. 10.1016/j.mambio.2019.03.002.

Musila, S., R. Syingi, G. Nathan and I. Castro-Arellano. 2018. Bat activity in the interior of Arabuko-Sokoke Forest and adjacent farmlands in Kenya. Barbastella. 11. doi:https://doi.org/10.14709/.BarbJ.11.1.2018.05.

Nash LT, Zimmermann E, Butynski TM. 2013. Galago senegalensis Northern Lesser Galago. In: Butynski TM, Kingdon J, Kalina J. Mammals of Africa, Volume II: Primates. London: Bloomsbury Publishing, 425–429.

Odhiambo R., Makundi R., Leirs H. and Verhagen R. 2005. Community structure and seasonal abundance of rodents of maize farms in Southwestern Tanzania. Belgium Journal of Zoology 135: 113-118.

Opiyo F.E.O., Ekaya W.N., Nyariki D.M. And Mureithi S.M. 2011. Seedbed preparation influence on morphometric characteristics of perennial grasses of a semi-arid rangeland in Kenya. African Journal of Plant Science 5: 460-468.

Palombit RA. 2013. Papio anubis Olive Baboon. In: Butynski TM, KingdonJ, Kalina J. Mammals of Africa, Volume II: Primates. London: Bloomsbury Publishing, 133–139.

Plumptre AJ, Wronski T. 2013. Tragelaphus scriptus Bushbuck. In: Kingdon J, Hoffmann M. Mammals of Africa, Volume VI: Pigs, Hippopotamuses, Chevrotain, Giraffes, Deer and Bovids. London: Bloomsbury Publishing, 163–172.

Polhill, R.M., W.B. Turrill, & E. Milne-Redhead (eds.) 1957 - 2012. Flora of Tropical East Africa (numerous vols.), Crown Agents, London. (Later volumes by other editors, and published by A.A. Balkema, Rotterdam.)

Pomeroy D. and Tengecho B. (1986). Studies of Birds in a Semi-Arid Area of Kenya. III-The Use of 'Timed Species-Count's for Studying Regional Avifaunas. Journal of Tropical Ecology, Vol. 2, No. 3. pp. 231-247.

Ray JC. 2013b. Civettictis civetta African Civet. In: Kingdon J, Hoffmann M. Mammals of Africa, Volume V: Carnivores, Pangolins, Equids and Rhinoceroses. London: Bloomsbury Publishing, 255–259.

Roberts NJ (2011). Investigation into survey techniques of large mammals: surveyor competence and camera-trapping vs. transect-sampling. Bioscience Horizons: The International Journal of Student Research, Volume 4 (1): 40–49. https://doi.org/10.1093/biohorizons/hzr006

Rödel, M.O. and Ernst, R., 2004. Measuring and monitoring amphibian diversity in tropical forests. I. An evaluation of methods with recommendations for standardization. Ecotropica, 10(1), pp.1-14.

Rowse, E.G., Lewanzik, D., Stone, E.L., Harris, S., Jones, G. 2016. Dark matters: the effects of artificial lighting on bats. Bats in the Anthropocene: conservation of bats in a changing world (eds. C.C. Voigt & T. Kingston), pp. 187–213. Springer International Publishing, Cham, Switzerland.

Russo, D., Ancillotto, L. 2015. Sensitivity of bats to urbanization: A review. Mammalian Biology 80, 205-212.

Sadlier LMJ, Webbon CC, Baker PJ, Harris S (2004) Methods for monitoring red foxes Vulpes and badgers Meles meles: are field signs the answer? Mamm Rev 34: 75–98.

Shannon, C.E. and W. Weaver. 1963. The mathematical theory of communication. University of Illinois Press, Urbana. pp. 238.

Simiyu, G. and Tole, M. P. (2000). Concentrations of trace elements in waters, soils, and plants of the Olkaria geothermal field, Kenya. Proceedings of the World Geothermal Congress 2000.

Spawls, S., Howell, K., Hinkel, H. and Menegon, M., 2018. Field guide to East African reptiles. Bloomsbury Publishing.

Stebbins RC. 1995. Off-road vehicle impacts on desert plants and animals. Pages 467–480 in Latting J, Rowlands PG, eds. The California Desert: An Introduction to Natural Resources and Man's Impact, vol. 2. June Latting Books.

Stevenson T. & Fanshawe J. (2002) Field Guide to the Birds of East Africa – Kenya, Tanzania, Uganda, Rwanda and Burundi. Christopher Helm London

Sutherland W. J. (1996) Ecological Census Techniques: A Handbook. Cambridge University Press

Szaz D., Horvath G., Barta A., Robertson B. A., Farkas A., et al. (2015) Lamp-Lit Bridges as Dual Light-Traps for the Night-Swarming Mayfly, Ephoron virgo: Interaction of Polarized and Unpolarized Light Pollution. PLOS ONE 10(3): e0121194. https://doi.org/10.1371/journal.pone.0121194

Száz D., Mihályi D., Farkas A., et al. Polarized light pollution of matte solar panels: anti-reflective photovoltaics reduce polarized light pollution but benefit only some aquatic insects. J Insect Conserv 20, 663–675 (2016). https://doi.org/10.1007/s10841-016-9897-3.

Takata S. 2013. Arvicanthis nairobae Nairobi Grass Rat. In: Happold DCD. Mammals of Africa, Volume III: Rodents, Hares and Rabbits. London: Bloomsbury Publishing, 384–385.
Taylor ME. 2013. Herpestes ochraceus Somali Slender Mongoose. In: Kingdon J, Hoffmann M. Mammals of Africa, Volume V: Carnivores, Pangolins, Equids and Rhinoceroses. London: Bloomsbury Publishing, 310–311.

Tews, J., U. Brose, V. Grimm, K. Tielbörger, M. C. Wichmann, M. Schwager, and F. Jeltsch (2004). Animal species diversity driven by habitat heterogeneity/diversity: The importance of keystone structures. J. Biogeogr. 31: 79–92.

Thomas, L., S. T. Buckland, E. A. Rexsta D, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. B. Bishop, T. A. Marques, and K. P. Burnham (2010). Distance software: Design and analysis of distance sampling surveys for estimating population size. J. Appl. Ecol. 47: 5–14.

Thomas L, Buckland ST, Rexstad EA et al. (2009) Distance software: design and analysis of distance sampling surveys for estimating population size. J Appl Ecol 47: 5–14.

Thorington RW, Schennum CE. 2013. Paraxerus ochraceus Ochre Bush Squirrel. In: Happold DCD. Mammals of Africa, Volume III: Rodents, Hares and Rabbits. London: Bloomsbury Publishing, 82–83.

Thouless CR. 2013. Tragelaphus oryx Common Eland. In: Kingdon J, Hoffmann M. Mammals of Africa, Volume VI: Pigs, Hippopotamuses, Chevrotain, Giraffes, Deer and Bovids. London: Bloomsbury Publishing, 191–198.

Tole M. P. and Coleagues (2011) environmental audit report Olkaria III geothermal power plant 2010

Visser, E., Perold, V., Ralston-Paton, S., Cardenal, A.C. and Ryan, P.G. (2019). 'Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa'. Renewable Energy 133: 1285–1294. Available at: https://doi.org/10.1016/j.renene.2018.08.106.

Wacher T, Kingdon J. 2013. Oryx beisa Oryx. In: Kingdon J, Hoffmann M. Mammals of Africa, Volume VI: Pigs, Hippopotamuses, Chevrotain, Giraffes, Deer and Bovids. London: Bloomsbury Publishing, 576–586.

Wilkinson, S. A. J., Craze, P. G. & Harris, S. 2004. Monitoring field vole (Microtus agrestis) in lowland Britain. The Mammal Society Research Report No. 4 The Mammal Society, London.

Wilson VJ. 2013. Sylvicapra grimmia Common Bush Duiker. In: Kingdon J, HoffmannM.Mammals of Africa, Volume VI: Pigs, Hippopotamuses, Chevrotain, Giraffes, Deer and Bovids. London: Bloomsbury Publishing, 235–243.

Zimmerman, D. A., D. A. Turner, and D. J. Pearson (1996). Birds of Kenya and Northern Tanzania. Russel Friedman Books, Halfway House, South Africa.

11 COLOPHON

Client	: Momnai Energy Ltd
Project	: Environmental, Social & Health Impact Assessment (ESHIA) for Solar PV Power Plant at Athi River, Machakos County
File	: Environment, Social Assessment & Resettlement
Length of report	: 213 pages
Author	: PANAFCON Ltd.
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